DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

D3.3 USE CASES REPORT

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Executive Summary and Key Outputs

In DESIRA, five Living Labs were selected to carry out use case workshops. The objective was to co-design a digital tool in each different context. To do so, the participants agreed on one or more goals to be reached. Building on both the focal question and the scenario question that each Living Lab has developed in previous activities, a use case statement has been co-developed to carry out use case workshops. The use case statement describes the goal(s) of the tool to be co-designed, the involved actors, and the needed ICT components.

The used methodology is described in this report, as well as the outputs of the process. The methodology has been adapted to the concept of socio-cyber-physical system that DESIRA developed, opening to discussions on impacts, drivers, and barriers as further step in the process, following the high-level design of the digital tool and of its main functionalities.

Each Living Lab identified what the participants deemed as needed in their region in terms of a novel digital tool. The presence of various stakeholders in Living Labs has made it easier to consider a wide range of needs since the very beginning, allowing everyone to have a role when it comes to the use of the co-designed digital tool. Such mechanism, not embedded in the typical use case methodology – which only clarifies the role of those considered as users by ICT designers – has been further strengthened in the workshops, therefore going beyond the traditional approach. In fact, by fostering discussions on impacts, drivers, and barriers, the proposed methodology has allowed the participants to reflect, early on in the process, on the potential impacts of the introduction of digital technologies.

Last but not least, it is worth pointing out that the outputs of the use cases, summarised in this document, provide a valuable starting point for software companies willing to design and develop digital tools not only according to users' needs and desires, but also tailored to the different rural contexts herein under consideration.

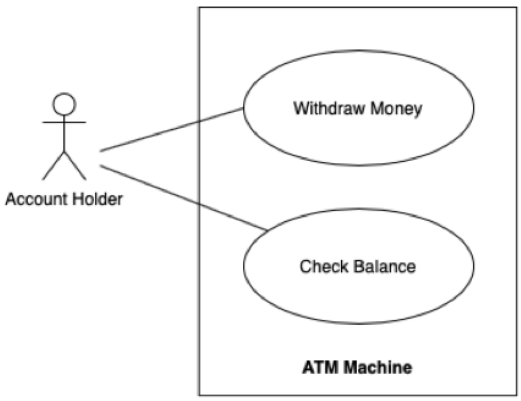
1. Use Case: General Definition and Application in DESIRA

Software-intensive systems are complex human artifacts and, as such, they need to be carefully engineered. System and Software Engineering (referred to as *software engineering* in the following) is the discipline dedicated to this task. It is equipped with languages and techniques for specifying a system at different levels of abstraction (user needs, user-system interaction, system architecture, detailed design, etc.) and for supporting project planning, system development, maintenance, and evolution.

Use cases are one of the classical techniques for representing **user-system interaction**. Use cases are typically defined during the early phases of software development with the aim of representing both possible user actions and expected system behaviours. Use cases are used both as a documentation means, to be later used for a more detailed system design, and as a live instrument to reason on the expected system behaviour and elicit potential issues, users, and implicit system requirements. Such reasoning is typically guided by an analyst, with expertise in software engineering, asking questions to the interested stakeholders. The latter are the domain experts, with a clear view of the issue at hand, available resources, and actors to be involved. Analysts may have a poor knowledge of the specific application and its domain, but they are able to formalize the problem thanks to the use case methodology, so that the next step of software developing can begin.

In more details, **use cases in software engineering are composed by:** (1) use case (graphical) diagrams, grouping together all the tasks to provide a complete vision, and (2) use case specifications (textual), which provide details for each task. Their representation is standardised as part of the Unified Modelling Language (UML) [1]. While the use case diagrams provide a graphical overview of the use cases and their relationships, the use case specifications define what users can do with the system. Users can request services, provide input to the system, collect output; all through a sequence of user-system interactions.

Let us consider for example an ATM machine. This system can perform several tasks, one for each possible service that the user could request. For instance, services like "*Withdraw Money*" and "*Check Balance*". The use case diagram for the ATM machine is represented in Fig. 1, together with a simplified specification of the "Withdraw Money" case.



Use Case Diagram

- Use Case Name: Withdraw Money
- User: Account Holder
- Steps:
  - The user inserts the card
  - The user inserts its PIN
  - The user selects the desired amount of money
  - [...]

Use Case Specification (for Withdraw Money)

Fig. 1 Example of a Use Case Diagram and a Use Case Specification.

Real-world use case specifications can be more complex, and the interested reader can refer to [2] for some examples. However, the fundamental spirit of a use case specification - i.e., detailing interaction steps - is entirely described by the previous example.

1.1. What are Use Cases in DESIRA?

In DESIRA, use cases are adapted to the concept of socio-cyber physical (SCP) systems. Technical notations exist to express properties of these systems and design them (e.g., *i** [3], TROPOS [4]). However, they are mostly oriented to system and software engineers and require appropriate editing tools, thus they will not be used in DESIRA.

A use case in DESIRA shall be regarded as a high-level description of the fundamental elements of a SCP system. Each Living Lab (LL) has a focal question, identifying a topic of interest for a given community in a geographical area. The introduction of technologies can support the communities in that area to take advantage of digital solutions in the context of their focal question. Thus, **use cases can be understood as the description of a future SCP system in which selected digital solutions are used to achieve the objectives defined in the focal question** (how to derive a use case statement from the focal question is explained later in this document). Let us give the following reference definition for the concept of use case in DESIRA.

In DESIRA, a USE CASE is a description of GOALS to be achieved, TASKS supporting the goals, involved ACTORS, and physical and digital COMPONENTS of a SCP system.

With respect to traditional use cases, in this definition, the *user* becomes an *ACTOR*, as some of the subjects in the SCP system may not directly interact with the digital part of the system (thus, they are not *users* of the system, strictly speaking). Furthermore, the services offered by the system are defined as *GOALS* to be achieved, meaning that the description of the use case shall make evident how the new services offered by the system meet the predefined goals. Finally, the *behaviour* is intended as the steps that involve interaction with the SCP system in terms of digital (cyber) and physical *COMPONENTS*, as well as other actors.

2. Methodology to develop use cases

In the following, the ingredients of the proposed use case methodology for DESIRA are described. Specifically, four main concepts are presented: the *input*, the *initial step*, the *expected output*, and the *process* to be followed to produce the output starting from the initial step.

The process leverages inputs coming from previous DESIRA activities (i.e., WP2 and WP3 workshops) to firstly define a *use case statement*, i.e., a brief description of the use case, and then decompose it into relevant elements (actors, goals, tasks, and components).

1.2. Input

Use case workshops build on the input coming from previous activities carried out in DESIRA. The output of previous activities provides a toolkit, composed of the following elements:

- The inventory of digital tools to browse existing or under development technology;
- The CPS conceptualization in four different functionalities (sensing, transmitting, computing, and intelligence) as composable high-level blocks to describe the novel system in the CPS terminology;
- The output of WP2 workshops;
- The output of WP3 scenario workshops, having as reference the *positive plausible scenario*;
- Existing technology already in use in the area or mentioned in previous activities within the LL, which can be considered as directly or indirectly related to the focal question.

1.3. Initial Step

Starting from the focal question and using the *positive plausible scenario* as main reference, a *clear*, *realistic*, and *generalisable* **use case statement** must be defined.

The **use case statement** is a brief (one or two sentences) description of the system in terms of goals to be achieved together with the main technical solutions envisioned and main subjects involved. The use case statement summarises what will be described in detail during the workshops. It can be regarded as a refinement of the focal question, to be used as a stable reference point that provides orientation to the workshops themselves. An example is reported below, considering as focal question the exemplary one *"how to reduce the risk of forest fires?"*:

> *Example of use case statement: the goal of the system is to improve the prevention and the control of forest fires involving citizens, public authorities, and other stakeholders. The system relies on a mobile app, on data collected from different sources (e.g., satellite, by citizens through the app, ...), and on the use of aerial and terrestrial drones in dangerous situations.*

The use case statement is required to fulfil three quality attributes:

- **clarity**: it means that it is well defined and not ambiguous (at least for all the participants in the workshops);
- **feasibility**: it means that the statement stems from the LL focal question and is feasible with known / existing technology;
- **generalizability**: it means that the statement should be realisable in general settings *as much as possible* (not contextually constrained by the LL specificities, e.g., too strict constraints in terms of costs, certification, permissions from authorities, ...): in this way, the output can be generalized to (reused in) other contexts.

The use case statement is not *immutable*; however, it should be subject to minor modifications only once agreed among participants.

1.4. Expected Output

The expected output of the use case workshops is a **use case specification**. It consists in the decomposition of the system, as briefly outlined by the use case statement, in terms of the following elements (*examples in the parentheses refer to the example statement above*):

- **actors:** involved actors (e.g., *firefighter, citizen, municipality, local entities*);
- **goals:** desired objectives to be achieved by the system as described in the use case statement (e.g., *prevent fires, control fires, involve citizens*). The goals highlight all types of objectives, including all the aspects that need to be addressed and that are the starting point to guide the behaviour specification of the system. The goals can be regarded as the motivations behind the development of the systems.
- **tasks:** activities performed by actors by/through/with the system to achieve the goals (e.g., *periodical checks, planned interventions*);
- **ICT components:** digital system components used by actors to perform tasks (e.g., *intervention-planning platform*, *mobile phones, GIS, drones, sensors*)
- **task descriptions:** step-by-step textual specifications of how tasks are performed by the actors to achieve a certain goal, taking into account: actors involved, action

performed in each step and motivation for the action. Ideally, each step should include only one action, but can involve multiple actors. The task descriptions are expressed in terms of:

1. **task name**
2. **actors involved**
3. **envisioned steps:** decomposition of the task into steps. Each step shall be expressed according to the following format: **The [ACTOR] does [ACTION] because/to [MOTIVATION].**

> *example*
> *the local government fire department flags geographical areas in a digital map for checks to ensure low risk of fires in those areas in the summer season.*

- **impacts:** potential desired and undesired short and long-term consequences related to the development of the system. The goals of the system, if achieved, may have certain impacts. Impacts belong to the following dimensions: ***social, environmental, economic, and governance*.**

> *examples*
> *Environmental: greater protection of trees in the area*
> *Social: greater sense of community.*
>
> Impacts can be positive or negative.
>
> *Economic: increased tourism in the area (positive)*
> *Social: exclusion of subjects who cannot use technology (negative).*

- **drivers:** any factor (phenomenon, event, or individual/collective need) that could facilitate the achievement of a certain goal. Drivers belong to the following dimensions: *social, environmental, economic, and governance.*

> *examples*
> *Economic: increased funding from regional government.*
> *Governance: need to increase controls in the area.*

- **barriers:** any factor (phenomenon, event, or individual/collective opposition) that could hinder the achievement of a certain goal. Barriers: belong to the following dimensions: *social, environmental, economic, and governance.*

> *examples*
> *Governance: complexity of regulations.*
> *Social: opposition to technology; aging population.*

The fundamental element of the task description is the **list of envisioned steps**, which describes the behaviour of the final system. This list shall be elicited by answering, and documenting, the following questions:

1. **How is the task performed now?** (list of current steps)
2. **Which are the weaknesses / issues of the current approach?** (list of issues)
3. **How can this be supported by an ICT system / digital tool?** (list of envisioned steps)

Although the task description includes only the envisioned steps at point 3, the list of current steps and the list of issues (point 1 and 2) are strongly encouraged to facilitate the reasoning among participants, and to better understand the role of novel ICT systems to be potentially introduced (as per the use case statement).

Fig. 2 shows the graphical relationship between the conceptual elements listed above (except for the task description, which are textual by nature). A *task* **involves** one or more *actors* and **supports** (i.e., contributes to achieve) a *goal*. A goal can be **supported** by multiple tasks. Each task **uses** one or more *ICT components*. Tasks and goals may **have** impacts to be identified. The achievement of goals can be **facilitated** by drivers and **hindered** by barriers.

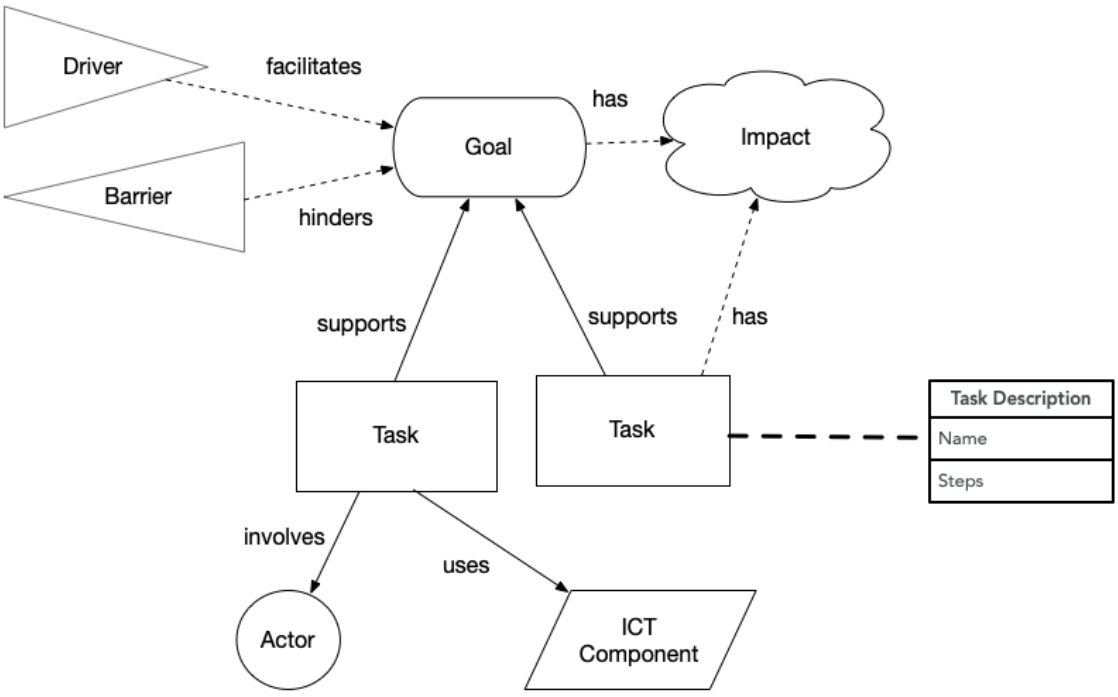


Fig. 2 Meta-model used to describe the relationships among goals, actors, tasks, ICT components, and to link goals with impacts, drivers, and barriers.

1.5. From the Use Case Statement to the Use Case Specification

The process through which the work progresses from the initial use case statement to the use case specification is composed of **two phases**, followed by an **assessment phase**. At the beginning, a **linear set-up phase** must be followed, which aims at collecting initial lists of actors, goals, tasks, and ICT components through brainstorming. Then, an **iterative refinement phase** is foreseen, in which the task descriptions are detailed, and the lists of elements (actors, ICT components, etc.) are further enriched if needed. Finally, the assessment phase must be performed to evaluate the use case from non-technical perspectives, and impacts, drivers and barriers must be elicited. Refer to Figure 3 for a graphical overview.

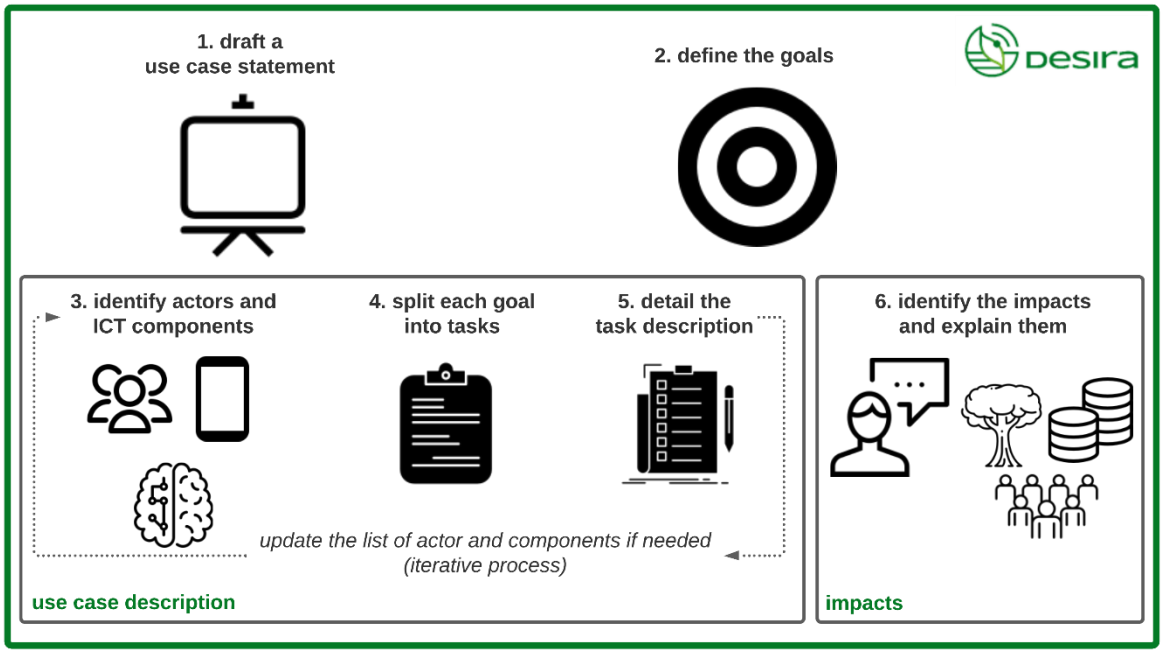


Figure 3: infographic describing the steps to build use cases in DESIRA.

1) **Linear Set-up Phase:** this phase starts with the definition of a use case statement, followed by the definition of the main goals to be achieved by the system (steps 1 and 2 of Figure 3).
Then, the participants are asked to identify the actors and the ICT components (step 3 in Figure 3). It is likely that the actors to be considered have already been identified in WP2 workshops, while ICT components of interest must be identified. At this stage, ICT components are roughly listed as the devices that are expected to be of use (e.g., drones, mobile phones, etc.). Additional ICT components and actors may be identified during the iterative refinement phase (see point 2).
Once preliminary lists of actors and components are compiled, split each goal into tasks (step 4 in Figure 3): in other words, identify a proper number of sub-activities that are deemed necessary to fulfil the goal (e.g., *periodical checks of the forest, planning interventions to dispose of dry vegetation in guard areas, etc.*).

Additional goals should not emerge in this phase (i.e., the use case statement should be already finalised). Instead, tasks may need to be redefined during the discussion to better reflect new ideas coming up in the workshops. During this phase, *completeness is not required*, while it is more appropriate to brainstorm and identify a preliminary list of key ICT components to be used as ingredients in the next phases.

2) **Iterative Refinement Phase:** it consists in providing detailed task descriptions (step 5 of Figure 3) and potentially refining the original sets of elements by adding or removing actors and ICT components. This phase is *iterative*: during the description of a task, it may become evident that some actors were not initially considered, but their presence is required for some reasons. In the same manner, the task description may highlight that some actors initially considered are not associated with any goal or any task description, and therefore must be excluded. Thus, step 5 in Figure 3 may require you to go back to step 3 to refine the list of considered elements; once done, check that the identified tasks are still consistent with the updated lists of elements before resuming the task description.

It is worth remarking that the task description phase aims to answer the question "**How can this task be supported by an ICT system / digital tool?**" by defining a list of envisioned steps. The digital tool or system that the LL describes in the use case workshops will support the desired future system (*system-to-be*). Thus, the use case describes how the digital tool should work if it were to be implemented.

3. The 5 Use Cases in the DESIRA Project

5 Living Labs have engaged in workshops, focus groups, and interviews to build use cases. This work builds on the analysis of the context carried out in WP2, and on the scenario workshops carried out in WP3. In particular, the *positive plausible scenario* [7] is used as reference framework within which the co-designed digital tools should have a role. In the following, we present the Living Labs that have carried out use cases, and then we present the 5 digital tools they co-designed.

3.1 How were the Living Labs selected to take part in this exercise?

All LLs have been encouraged to participate in use case development. The selection of the 5 use cases has been done a) on the willingness of the LL to carry out the related activities; b) on the LL familiarity with the concept of use case; c) on the technical competences available within the LL. The DESIRA Rural Digitalisation Forum (RDF) has indirectly added a criterium, that is the clarity of the vision of the rural problem in relation to the technological solution. The second RDF meeting focused on the WP3 scenario planning workshops, highlighting how *the digital future of rural areas depends on the vision we have now*, and how *the rural solutions should be different from urban ones* [5]. Those recommendations are embedded into the methodology to different extents: the proposed digital tools have been co-designed considering present needs but having in mind the positive plausible scenario mentioned above, and such tools deal with social and economic needs that are intrinsic to the rural areas under consideration.

3.2 Use case summaries and statements

Each Living Lab, as described above in the methodology section, has formulated a *use case statement*, i.e., a short description of the system in terms of goals to be achieved. The use case statement can be seen as a further refinement of the LL focal question [6]. Table 1 recalls the focal question of the Living Lab, and how it has been transformed for the purpose of scenario workshops [7].

Table 1: focal and scenario questions used in workshops by the 5 LLs building use cases.

Living Lab	code	focal question (see D2.2 [6])	scenario question (see D3.1 [7])
Tuscany, IT (land management)	IT	How can better communication among citizens, stakeholders and public administration make ordinary land management in marginal rural areas more effective?	How will the ordinary land management in mountain areas of the Reclamation Consortium "Toscana Nord" be managed in 2031? What role will digital technologies play in this process?
Trikala, GR (digital services for rural and farmer communities)	GR	How to develop new digital services for rural communities based on using the existing agricultural infrastructure and tools? How can these services support both the economy and farmers' income in rural communities?	How to develop new digital services for rural communities based on using the existing agricultural infrastructure and tools? How can these services support both the economy and farmers' income in rural communities?
Rhineland-Palatinate, DE (communication and gender)	DE	How can the local administration cope with the internal and external challenges of the digital transformation and integrate citizens as well as other local actors into this process?	What will digital living (together) look like in Betzdorf-Gebhardshain in 2031?
Austria, AT (roundwood traceability)	AT	How can digitalisation support and enforce the adoption of the European Timber Regulation (EUTR) concerning round wood in Austria and how easy and effective is a wide adoption of new solutions?	What will timber tracking look like in 2031 in Europe?
Scotland, GB (Scottish crofting community)	SCO	What are the most appropriate pathways to equitable and beneficial digitalisation for crofting communities in 2030?	What will crofting communities be like in 2031 given future digitalisation?

Building on both questions, each Living Lab has drafted, agreed, and finalised a use case statement, as presented in Table 2.

Table 2: the 5 use case statements proposed by LLs.

Living Lab	code	use case statement
Tuscany, IT (land management)	IT	Integration of climate and hydrologic data, human monitoring activities, and land management activities to improve the efficiency of land management, especially in terms of reducing response times to citizens requesting interventions. The system foresees a web application leveraging data collected from different sources (including satellite data).
Trikala, GR (digital services for rural and farmer communities)	GR	Development of a system for collection, gathering and analysis of data across the wine supply chain (from grape producers, towards vineyards and wineries, up to wine consumers). The system aims at enhancing the traceability and security aspects of the products, as well as increasing resilience in the wine value chains while strengthening the position of farmers and wine producers in the market.
Rhineland-Palatinate, DE (communication and gender)	DE	Bring citizens of different generations and backgrounds together in different locations to foster communication, exchange of knowledge, and joint activities on different topics. The system relies on a web application, assuring a high degree of usability on mobile and fixed devices, features geo-functionalities, with software interfaces to connect to existing digital services in the region.
Austria, AT (roundwood traceability)	AT	Provide global single-tree roundwood traceability involving loggers, traders, and processors to strengthen the forest ecosystem resilience. The system relies on a mobile tagging device and on data collected from remote sensing systems, i.e., satellites for global positioning and optical satellites for verification.
Scotland, GB (Scottish crofting community)	SCO	Provide information on training opportunities on one platform (signposting) using gamification techniques to engage and entertain players. The system relies on a simulated environment and 360-degree footage with embedded resources to inform players of the game.

Each Living Lab has thus defined an objective to be met by means of a digital tool. The chosen objective is specific to each context and related to the LL focal question. It is also evident that the definition of a use case statement is tied with the identification of concrete objectives, and of actions to be put in place towards said objectives. In other words, participants will engage with 1. splitting objectives into simpler tasks as subsequent steps needed to reach them; and 2. make sure that each task is (or is as close as possible to) a concrete action that can be put in place in their context. Such analysis is of great value for IT analysts because it provides a preliminary but effective description of what the users

would like to see implemented as a software product, well-tailored to their needs. From that, recursive steps of analysis can be undertaken to further define the product, its expected behaviour, and the overall user experience (UX), following the life cycle model of software development (see Fig. 4).

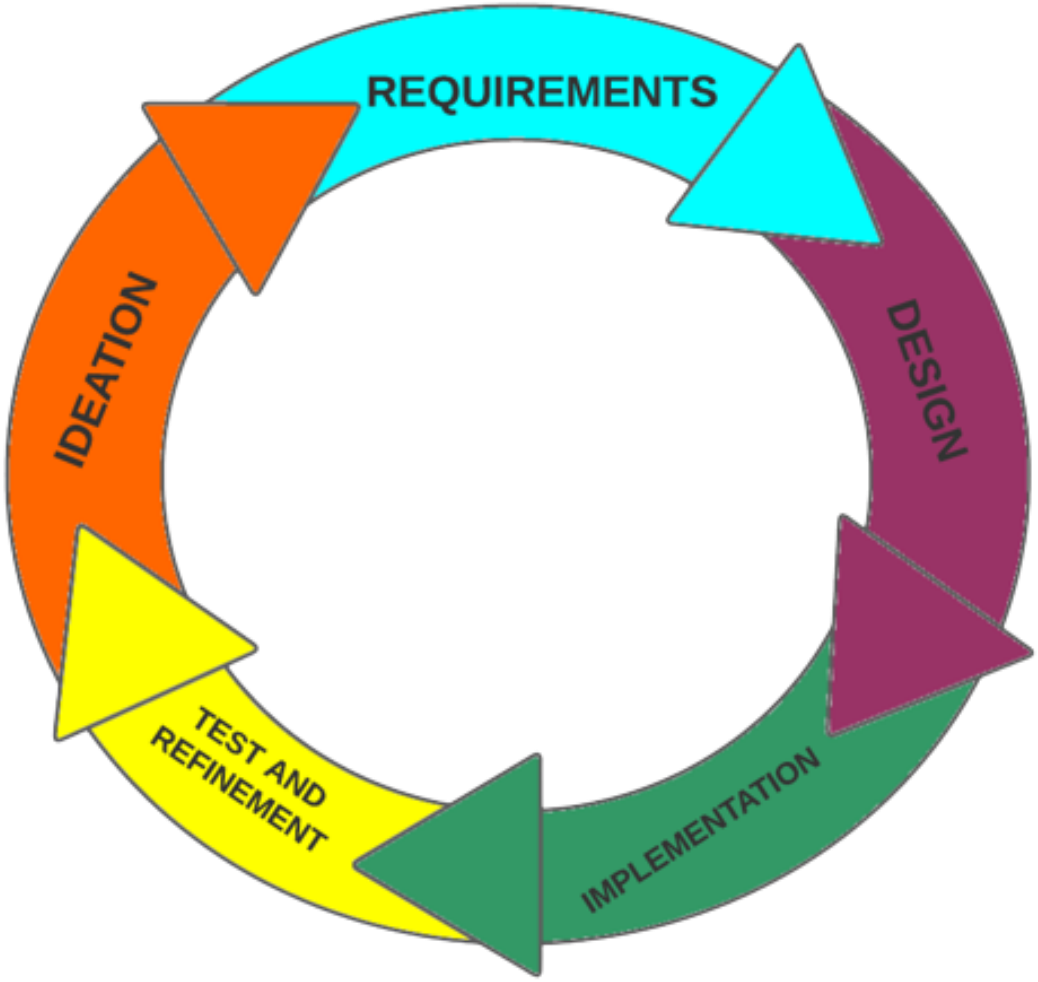


Figure 4: software lifecycle. The process followed by Living Labs in DESIRA has covered the initial phases: *ideation, requirements collection,* and *preliminary design*.

3.3 Extended descriptions of the use case statements

To better understand the context in which each Living Lab has operated and the need behind the use case statement in Table 2, we summarise key information about each LL below.

SCO: Providing information on training opportunities for crofters in isolated communities, and often remote from these communities, has proved challenging because of the remote geographical locations. Recently, farming/crofting organisations have used newsletters to notify people of training opportunities and then moved to webpages, social media, and local community websites. However, engagement and take-up of opportunities are limited. Using gamification, the James Hutton team is planning the development of a tool, namely DigiTool, to entertain players whilst informing them about training opportunities tailored for them. The DigiTool hopes to **deliver clear messages that are focused within a unique environment targeted to engage the crofting (and smallholding) community**. A simulated crofting community environment will be developed by a software developer that will be augmented with 360-degree footage to allow a bespoke experience to be created. The information spheres will deliver information on training opportunities to engage players and inform them on the background of the topic as well as directing them to event pages giving times and dates of training opportunities, allowing players to register their interest. The game will also provide lasting resources that offer learning experiences as well as inform them of events that they can engage with.

AT: Austria has a strict, long-existing forest law guaranteeing sustainability: the word sustainability originates from the forestry domain[1] and is defined as guaranteeing more growth than felling. Nevertheless, to fulfil the yearly demand for roundwood, timber is acquired from the European and international markets. This poses the threat of illegal deforested products being sold on the European market, which is what the EUTR is tackling; illegality is not only cutting down endangered tree species, but also breaching national forestry laws. The use case reflects the work of the Austrian start-up BeetleForTech, working to provide a solution for the **seamless traceability of roundwood to contrast illegal activities**. Digitalisation allows information to travel faster and more transparently, helping in the contrast of clandestine activities. While the forestry domain is experiencing a high degree of technological advancement, the tackling of illegal logging is still slowed down by institutional circumstances and may benefit from novel digital solutions.

GR: This Living Lab focuses on the co-development of digital solutions with farmers that are located in rural areas of Northern Greece. It initially started its operation in the area of Trilofos, in the municipality of Katerini. This region has a long tradition of tobacco cultivation, but in recent years the position of the local farmers in the supply chain has been weakened, mainly due to the production limitation system the EU applied to tobacco, and to the suspension of subsidies. In its first stage, this Living Lab delved into the identification of digital services and functionalities to propose suitable digital solutions for a group of experienced farmers gradually transitioning from tobacco to leek cultivation. But the lack of a short-midterm revenue prospect, support from local authorities, and the difficulties that the cultivators faced in adjusting their agricultural routines to ICT solutions have led them to abandon agricultural activities. Because of this, the Living Lab entered its second stage, keeping its focus but changing its geographical location to Goumenissa, an area well-known for the cultivation of grapes. A wide group of grape cultivators and winemakers-owners has been involved to collaboratively experiment with new digital solutions that will **improve the local wine supply chain** and leverage functionalities that can **provide quality guarantees for the creation and establishment of a distinct local wine product**.

IT: The Living Lab Toscana Nord has been organized around the activity of land and water management carried out by the local public authority Reclamation Consortium “Toscana Nord” (RCTN). RCTN was created in 2012 when the activity moved from the local level of Municipality Unions to a larger scale, making it responsible for the management of an area of about 360.000 ha including both mountain and plain areas. RCTN is leveraging **digital tools to manage citizens’ alerts** on the need for **ordinary maintenance to prevent floods and landslides** downstream. The direct involvement of citizens allows an increase in the efficiency of land monitoring and management. In particular, the citizens’ contribution in signalling the need to remove obstacles on upstream small watercourses, which are hard to reach by the RCTN staff, has a significant impact on preventing damages downstream. The Living Lab is discussing how to improve the functioning of digital services - implemented as a mobile application - and how digitalization can support the system to **improve both the efficiency of land management and the reduction of response time to citizens**.

DE: The living lab in Rhineland-Palatinate is situated in the collective municipality of Betzdorf-Gebhardshain, which consists of 17 single municipalities. Betzdorf-Gebhardshain struggles with problems typical for rural areas in Germany, such as depopulation, limited job offers and educational opportunities. The LL deals with the opportunities of digitalisation for intensifying exchange between local authorities, citizens, the economy, and institutions of civil society. "**Bringing People Together**" is the name of the digital tool meant to **facilitate personal exchanges among people** in the municipality of Betzdorf-Gebhardshain – including groups and individuals who are usually less likely to interact with each other. Emphasis is put on the intergenerational aspect, but also citizens with a migration background are mentioned. Thus, the tool aims at bringing together young as well as elderly people, but also old-established citizens with newly arrived residents.

4. Comparative analysis

A comparative analysis was carried out, to identify similarities and differences between the considered use cases in terms of different dimensions, namely: 1) meetings and participants 2) goals; 3) actors; 4) technologies; 5) limitations of the existing systems; 5) proposed solutions. The analysis was carried out by performing a thematic analysis [8, 9] across the different dimensions and using the use case reports as the main data source. Specifically, one researcher identified the different entities (goals, actors, etc.) for each dimension across the use case reports, and created overarching categories, and crosscutting concerns. Note taking was used to support the creation of overarching categories and identify relationships between them, based on the data. When missing information was identified, the LL coordinators were contacted to provide clarifications. The definitions of the categories and their derivation from the data sources were assessed by a second researcher, to ensure clarity. To validate the categories, the coordinators of the selected LLs also reviewed the content of the present deliverable. In the following sections, for each dimension, we present and discuss the items of each LL, and the overarching categories and crosscutting identified, together with reflections concerning these aspects. Furthermore, in relation to the proposed solutions, we present overall graphical representations of the proposed systems, based on the different entities elicited and reported in the LL reports.

4.1 Meetings and Participants

The number of participants and the type and duration of meetings is reported in Table 3.

Table 3: number of participants and meetings the 5 LLs carried out to develop use cases.

LL	Meetings, workshops, and other activities	Participants
IT	approx. 6h in focus groups	approx. 10 participants
DE	approx. 8h in focus groups and workshops	approx. 12 participants
AT	approx. 6h of interviews	approx. 3 participants
GR	approx. 7h in focus groups and interviews	approx. 15 participants
SCO	approx. 7h in focus groups and workshops	approx. 4 participants

4.2 Goals

From the analysis of the goals of the LL, later described in Table 4, we identified a set of *overarching themes*, further partitioned into codes derived from the goals themselves. The codes are reported in square brackets in Table 4, to trace each goal to the specific code.

Four overarching themes have been identified, namely *People*, *Process*, *Sustainability*, and *Data Management*. These are the classes of goals addressed by the proposed UCs of the LLs. In the following, we describe the themes and goals, while Figure 5 illustrates the relationships between these elements. *People* improve *processes* which, in turn, aims at improving *sustainability* aspects. To this end, processes leverage *data management* approaches.

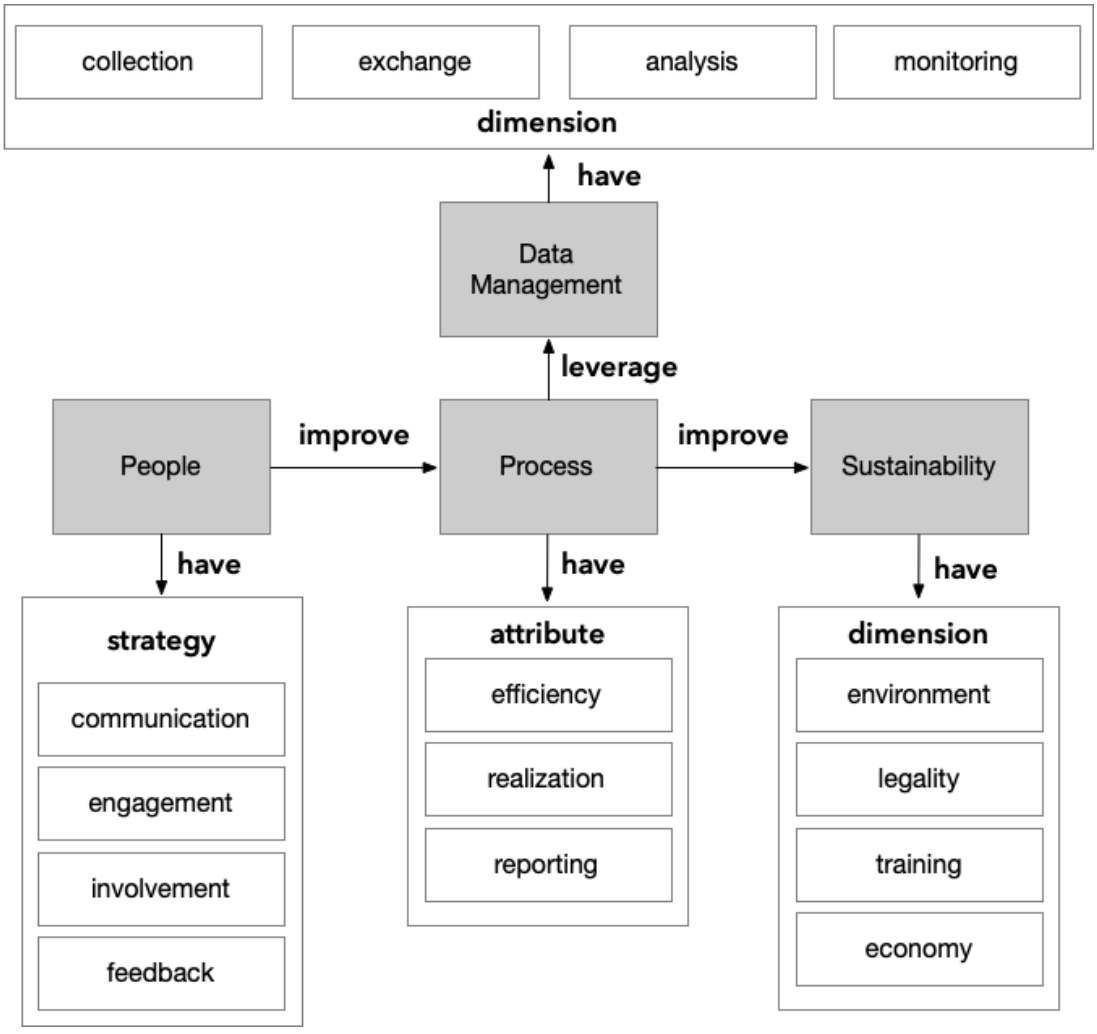


Figure 5: overarching themes (people, process, sustainability, and data management) in the goals selection within LLs. Each theme is further detailed into codes (e.g., the *data management* theme is further split into *collection*, *exchange*, *analysis*, and *monitoring* subthemes or codes).

People (actors)*:* the goals within this theme are mainly concerned with community aspects, and include involvement of people, engagement, communication, and feedback. People are normally involved in processes (cf. the following theme), and the goal is generally to involve people to improve a certain process.

- **INVOLVEMENT:** involvement of different actors and citizens is regarded as a major goal by the IT and DE LL, which are the ones mainly driven by public needs. While IT aims to involve

citizens and farmers in the improvement of a monitoring system for land management, DE aims to involve citizens in the creation and management of events for the community. Overall, involvement is mainly directed towards the good of the community.

- **ENGAGEMENT:** involvement of people requires some form of engagement, to keep the actors involved in the process. IT fosters engagement by assigning responsibilities to people, mainly farmers, for the monitoring of the territory, and for the actual interventions. SCO fosters engagement by creating an attractive digital platform, which creates a form of gamification. DE uses feedback loops between event organisers and participants to support engagement, and we can assume that the need of village inhabitants to be part of the community can act as a trigger for involvement.
- **COMMUNICATION:** this goal is central to the LL for which involvement of people is a primary concern, namely IT and DE. IT aims to facilitate communication between citizens and public administration, to support the process of ordinary land management, while DE wants to facilitate communication between the citizens themselves, so that information about events can be better circulated in the community.
- **FEEDBACK:** the goal of continuously improving the process with the contribution of people needs to resort on feedback strategies, which can identify current pros and cons of the process in place. Feedback is explicitly mentioned by DE, SCO, and GR. DE needs feedback to improve events and their organisation. SCO needs feedback on organised training courses, and GR needs feedback to improve production. Feedback appears to be a cross-cutting concerns of both public-oriented (DE, SCO), and private-oriented LL (GR).

Process: the goals within this theme are concerned with the directions for improvement of the current process. While the means (or strategies) for improvement are defined as part of the goals of People, the expected effect of the process improvement can be better efficiency, actual realisation of a certain output, and better reporting on the process.

- **EFFICIENCY:** improving current drawbacks in terms of inefficiency of the process, especially due to communication difficulties, is the objective of IT and GR LL, thus a cross-cutting concern of public-oriented and private-oriented LL. IT aims to improve the efficiency of land management through a better circulation of information, while GR aims to improve efficiency thanks to a more structured information flow about wine production.
- **REALIZATION:** this is a goal that is specific to DE and IT, which wants to involve people for the actual realization of the output of the envisioned processes, i.e., events for IT, maintenance work for DE. Realization, however, is an implicit goal also for the other LL, though the outputs are less direct. For example, the main goal of SCO is the access to training, but the indirect goal is realization of training courses. Similarly, the indirect goal GR is a traceable wine production, while the one of AT is a traceable wood production.
- **REPORTING:** the goal is specific to DE, which aims to use reporting to give evidence to the output of the process, i.e., the organised events. This explicit goal can be borrowed by the other LLs, especially IT---to show that certain maintenance works are realised---and SCO---to show the results of training courses.

Sustainability: improvement of processes aims to achieve higher-level goals related to sustainability. these goals are concerned with different dimensions of sustainability, namely environmental sustainability (environment), social sustainability (training), policy-related aspects (legality), and economic aspects (economy).

- **ENVIRONMENT:** this overarching goal is specific to AT and IT. which aims to improve environmental sustainability through better tracing of wood (AT), and through better management of the territory (IT). Therefore, environmental sustainability is a primary concern.
- **TRAINING:** training is related to social sustainability, as a better training can contribute to access to technology and in turn facilitate economic growth. This is the primary goal of SCO, which aims to provide better training to farmers, and one of the goals of DE, which aims to foster events circulation, including training opportunities.
- **LEGALITY:** this goal is specific to AT, for which enforcement of legal constraints to ensure better traceability of wood is a main concern. Nevertheless, policy-related aspects implicitly emerge for IT and GR. IT needs a better system to monitor maintenance work, to facilitate the assignment of responsibilities, in case of issues following extreme weather events. GR can use the improved traceability of the wine production process to foster the creation of quality labels and provide evidence of adherence to production protocols.
- **ECONOMY:** economic sustainability is a primary concern of GR, as one of the limitations addressed is the possibility of access to larger markets, which could be enable by a better tracing and quality control of wine production. For the other LL, economic aspects are somewhat by-product of the process improvement, e.g., for IT, it would be the reduction of the need for extraordinary maintenance, and for AT the greater public income thanks to reduced illegality in logging.

Data Management: processes are improved through digital technologies mainly through a better data management approach, including data collection, exchange, analysis, and monitoring. Data are considered both as structured data coming from sensors, and unstructured data such as messages from citizens (feedback, notifications, etc.).

- **DATA COLLECTION:** this is one of the main goals for all the LL: IT (collection of notifications from citizens and farmers), DE (feedback from event participants), GR (data about wine production processes and consumer's feedback), AT (collection of traceability data), SCO (collection of feedback). Collected data are automatically analysed, mainly in case structured data, or exchanged, mainly in case of unstructured information.
- **DATA EXCHANGE:** data exchange is a primary goal for IT, which aims to better circulate information about the status of the territory, leveraging data coming from citizens, and sensors. This goal is considered also by GR, which aims to foster exchange of data within the wine production supply-chain.

- **DATA ANALYSIS:** data analysis is required whenever a certain action should take place based on the content of the data. This includes analysis of feedback and notifications (DE, SCO, IT), and analysis of data from the supply-chain, as in the case of GR.
- **MONITORING:** monitoring can be regarded as a higher-level goal of data collection and analysis. The monitoring of the LL environment, in terms of territory (IT), in terms of traceability constraints (AT), and in terms of supply-chain data (GR) is an essential objective for most of the LLs.

Table 4: Goals by LL, with associated codes in square brackets for each goal.

LL	Goals
IT	**Improve the efficiency of maintenance work:** this goal aims to avoid floods and landslides in mountain areas, and it is needed to prevent damage downstream with appropriate land management intervention. **[EFFICIENCY] [REALIZATION] [ENVIRONMENT]** **Improve the communication between citizens and Public Administration:** this goal aims to reduce the time of the public administration for answering the citizens when they notify a need for intervention. **[COMMUNICATION]** **Involve citizens' associations and farmers in the monitoring of watercourses:** this goal aims to manage data resulting from the monthly reports of watercourse monitoring developed by 100 farmers and 100 citizen associations who signed an agreement with the Consorzio Toscana Nord to be responsible for the monitoring of specific watercourses. **[INVOLVEMENT] [ENGAGEMENT] [DATA COLLECTION] [DATA EXCHANGE] [MONITORING] [DATA ANALYSIS]**
DE	**Offering an event:** all persons registered on the platform (users) can publicly discuss topics, seek for helpers, and offer events. **[COMMUNICATION] [TRAINING] [INVOLVEMENT]** **Activating participants:** information and feedback functionalities allow organisers of events to invite other users and receive suggestions [**COMMUNICATION] [FEEDBACK] [ENGAGEMENT] [DATA COLLECTION] [DATA ANALYSIS]** **Supporting an event:** in addition to the setup and preparation of events, the system also supports the organiser as well as participants with the realisation of an event **[REALIZATION]** **Documenting an event:** events facilitated by the system can be documented and publicly reported **[COMMUNICATION] [REPORTING]**
AT	**Provision of global roundwood traceability**: provide global traceability of roundwood involving loggers, traders, and processors. **[LEGALITY] [DATA COLLECTION]** **Strengthen forest ecosystem resilience:** traceability enables the possibility to check

	correct usage of resources, so that forest ecosystems are resilient. **[ENVIRONMENT][MONITORING]**
GR	**Monitoring and data capturing of the growing fields:** This goal aims to setup routines that will enable the collection and exchange of data and information and will further facilitate the adoption of digital tools on grape cultivation and wine production. **[DATA EXCHANGE] [DATA COLLECTION] [MONITORING]** **Data analysis and notification system in the wine supply chain:** This goal aims to establish procedures that allow the monitoring and ensure cultivation, standardization, and processing procedures **[MONITORING] [STANDARDIZATION] [EFFICIENCY][ECONOMY]** **Tracing and product authentication:** This goal aims in correlating production quality by growing region and attribution of production characteristics and traits in the final product. **[DATA ANALYSIS]** **Product feedback:** This goal aims to extend the grape growers and wine producers' agency over their product further down the supply chain and create a feedback channel with the consumers of their products. **[FEEDBACK][DATA COLLECTION]**
SCO	**Engage crofters with training:** the platform will engage crofters with the training by providing a 3D gamified environment. **[ENGAGEMENT]** **Point crofters to potential training opportunities:** the platform will facilitate the access to specific links describing training opportunities. **[TRAINING]** **Collect feedback on training opportunities:** data will be collected including feedback from training course participants, and about the need for specific training opportunities, as well as willingness to participate. **[FEEDBACK] [DATA COLLECTION] [DATA ANALYSIS]**

4.3 Actors

In Table 5, we report the actors for each LL, together with the codes associated to them. The actors can be grouped into *private* and *public* actors.

Private actors: these include individuals, businesses, and groups of individuals, as well as technology providers and consultants.

- **CITIZENS:** these are individuals, who can take three main roles: users of a certain technology (DE, for the event platform, IT for the communication system, AT for the tracing system), consumers (GR, wine consumers), and social actors (IT, for the communication of environmental phenomena, DE for the creation of events and participation). Citizens are important in all the LL, except SCO, which is mainly oriented to businesses.

- **BUSINESSES:** these include various private subjects, which have an economic interest in their involvement in the process. For example, farmers in IT, wine producers in GR, crofters in SCO, loggers in AT. Private businesses, together with public administrations, appear to be the ones that have most of the benefits from the improvement in terms of processes foreseen by the LLs.
- **GROUPS:** these are groups of citizens coming from the civil society, and aggregated into associations and similar entities, which target specific goals. They can be more or less institutionalised, with structured associations (IT), or groups created specifically for a certain event (DE). Though not common across all LL, they are relevant actors who can act as supporters for process improvement, as in IT, or for the success of initiatives, as in DE.
- **TECHNOLOGY PROVIDERS:** these are mentioned by GR, but they can assume a central role in each LL. Technology is rarely developed in-house by business entities and public administrations, so external providers frequently need to be involved.
- **CONSULTANTS:** these have an important role in GR and SCO. They are intermediaries which bring knowledge to wine producers (GR) and crofters (SCO). Though not explicitly mentioned by the LLs, IT-specific consultants are also needed to facilitate the introduction of the novel technologies, as agricultural consultants do not necessarily have IT-competences.

Public Actors: these include public administration entities, and institutions with specific goals, but also entities that are mainly oriented to the public good, such as newspapers.

- **PUBLIC ADMINISTRATION:** these are generic public entities without a single goal and include small entities such as municipalities (IT), or larger entities such as the EU commission (AT) or the national government (SCO). They play the role of general controllers, and beneficiaries of goals oriented to the public good (SCO and AT), but also as intermediaries in the information flow (IT).
- **INSTITUTIONS:** these can be regarded as public administration subjects with specific goals, e.g., education or certification of products. They play the role of supporters of the process, central management entities, or controllers. The role of supporters appears in DE, where educational institutions can provide educational events. The role of central management entities is the case of IT, in which institutions are at the center of the communication with citizens and the performance of maintenance work. The role of controller appears in AT (tracing of woods facilitates assessment by public institutions), and SCO (training is controlled by the Crofting Federation).
- **INFORMATION ENTITIES:** these are mentioned by DE, as newspapers, newsletters, or other sources of information can foster the circulation of advertisements for events. This role can in principle be played also in the other LL that involve citizens, for example IT (advertising the app for communication with the central institution), and SCO (advertising the platform, and its training courses). Though these are private entities, we group them into the public actors as they are primarily oriented to provide a service to the community.

Table 5: actors identified by each LL.

LL	Actors
IT	**Individual Citizens:** contribute to the notification of the need for maintenance works. **[CITIZENS]** **Farmers:** notify the need for maintenance works and in mountain areas is sometimes directly asked by the Consorzio to realize the specific maintenance work. **[BUSINESSES]** **Association of Citizens:** contribute to the notification of the need for maintenance works. **[GROUPS]** **Local authorities and administrations:** contribute to the notification of the need for maintenance works, often in the name of citizens who do not have sufficient digital skills to use the app for notification. **[PUBLIC ADMINISTRATION]** **Administrative staff of the Consorzio:** receive the notification from citizens and upload the information on the web app. **[INSTITUTION]** **Technical staff of the Consorzio Toscana Nord**: receive the notification from the web app and organize a physical inspection in the field, writing a report back to the director. **[INSTITUTION]** **President of the Consorzio Toscana Nord:** approve the answer to the citizens **[INSTITUTION]** **Chief Executive:** approve the report from the technician. **[INSTITUTION]**
DE	**Citizens:** comprising different age groups, different backgrounds (locals, new locals, migration background) and different interests. **[CITIZENS]** **Clubs:** institutions/associations of civil society which are formalised and established usually with a certain topical background **[GROUPS]** **Initiatives:** more lose forms of existing communities with certain interests and topical backgrounds **[GROUPS]** **Educational institutions:** such as schools, preschools, adult education centres, both, as institutions as well as their members (teachers and students) **[INSTITUTIONS]** **Administration:** the local administration of the municipality of Betzdorf-Gebhardshain and its members **[PUBLIC ADMINISTRATION]** **External information sources:** newspapers, local gazette, event sector **[INFORMATION ENTITIES]**
AT	**European Commission**: The European Commission (EC) is the high-level instance interested in preserving the forest ecosystem **[PUBLIC ADMINISTRATION]** **User**: A user, i.e., a private person or entity interested in tracing the origin of wood or wood

	products **[CITIZENS][BUSINESSES]** **National forest agencies:** National forest agencies are the national legal entities executing the agenda of the EC **[INSTITUTION]** **Loggers**: A private person or entity responsible for cutting down trees, in order to trade or sell the timber **[BUSINESSES]** **Operators & Traders**: A mostly internationally active agent or entity buying and reselling timber and timber products **[BUSINESSES]** **Processors**: An entity responsible to processing logs into various further wood-based products **[BUSINESSES]**
GR	**Grape Growers & Wine Makers:** In this use case Grape growers and Wine makers for the most part account for the same set of actors that hold a dual role but also describe distinct individuals that are solely occupied in the primary (grape growers only) or secondary sector (winemakers only). These actors are the main technology beneficiaries whose products will be the core (focus subject) for applying a traceability system across the wine supply chain. **[BUSINESSES]** **Wholesalers and Retailers:** Wholesalers and Retailers are the intermediary supply providers of the wine products in the market. They pose the important link between production and consumption and though are not actively included in the development process of the use case; they still hold a critical role that needs to be considered for the use case purposes. **[BUSINESSES]** **Wine Consumers:** Similar with the wholesalers and retailers, consumers describe a broader category of individuals that are not directly involved in the use case development holding a passive role. However, a key factor for measuring the efficiency of the use case application is through tracking consumer actions. **[CITIZENS]** **Technology Providers:** The description of technology providers applies for two types of providers, the first one is the infrastructure providers and owners (LoRaWAN network, sensors and Internet of Things devices) that are already (or will be in the future) installed in the region, and the second one describes the traceability system developers and administrators that provide Internet of Things (IoT) and tracking modules as well as farm and consumers apps that enable the systemization of traceability and control features in this use case. **[TECHNOLOGY PROVIDER]** **Agronomists/Agricultural consultants:** Agronomists play a crucial role for the functional operation of this use case. Grape growers and wine producers belong in a specific demographic profile that is characterised from the lack of digital competencies having also very limited previous experience with digital agricultural tools. Agronomists play a facilitating role that bridges the prevalent digital skill gap and ensures the actuation of digital tools in wine production as well as the active involvement of farmers with the new digital methods. **[CONSULTANTS]**

SCO	**Crofters:** a form of land tenure and small-scale food production **[BUSINESSES]** **Visitors of the Digital Platform:** targeted to crofters and smallholders, but open to all **[BUSINESSES]** **Smallholders:** small farms and other small activities in the area **[BUSINESSES]** **Training development officer of the Crofting Federation:** interested in the development of the tool and in its use and promotion within the federation for training **[INSTITUTION]** **Crofting Development Officers of the Crofting Commission:** interested in the development of the tool and in its use and promotion within the federation for training **[INSTITUTION]** **Chief executive of the Crofting Federation:** interested in the development of the tool and in its use and promotion within the federation for training **[INSTITUTION]** **Scottish Government:** DigiCroft as a digital tool to support crofters and smallholders and reduce digital divide **[PUBLIC ADMINISTRATION]** **Farm Advisory Service:** DigiCroft as a platform to offer training and keep in contact with crofters and smallholders **[CONSULTANTS]**

4.3 Technologies

Table 6 reports the different technologies identified to support the process, together with the associated codes. The technologies can be grouped into software and hardware.

Software:

- **APPLICATION:** this category includes mobile-oriented apps, such as communication applications (e.g., WhatsApp IT), or project specific applications (e.g., the consumer application GR), as well as desktop-oriented software, such as the profile and tracing modules of GR. Overall, applications are present in all LLs, and less dominant in the AT LL, as the use case in this case is more hardware and service/infrastructure-oriented.
- **APPLICATION-COMPONENT:** these are specific features offered by a certain application, such as the embedded links of SCO, or the different features offered by the application/web-portal of GR.
- **WEB-PORTAL:** this includes portals that can be accessed by users via Web to input data, or to read data, or both. Users can be common citizens or stakeholders with specific privileges. For example, the web-portal used to manage notifications in IT is handled internally by the central

authority and is not in principle visible to citizens. On the other hand, citizens and farmers are the information producers for this portal. Instead, the web-portal in DE is accessible to everyone to see the events, and citizens are the information consumers. In the case of GR, the portal is accessible to authenticated subjects, and the users are both information producers and consumers.

- **DATABASE:** this represents all the data-storage systems, which are used in all LL. Databases include public ones, e.g., public climate database in IT, but also databases accessible to authenticated users only, e.g., the database for the satellite data in DE, or the database for the wine production-related data in GR.

Hardware:

- **GENERAL-PURPOSE-HARDWARE:** includes typical general-purpose devices, such as mobile phones and computers. Despite their relevance in daily life, these elements are mentioned solely by IT and by DE. This indicates that are somewhat given for granted by the other LL, as, e.g., GR, for which such devices are needed to run the customer application.
- **SPECIFIC-PURPOSE-HARDWARE:** includes hardware that is designed for specific purposes, and that serves the needs of the project. For example, the devices used by AT to tag and scan trees, but also systems at the boundary with infrastructure/services, such as the Global Navigation Satellite System (GNSS), composed of physical satellites (AT), and the LoRaWAN gateway (GR).
- **INFRASTRUCTURE-SERVICE:** this includes all services that require a physical, and specific-purpose infrastructure to operate, for example the cloud services (AT, GR), or GNSS (AT). These infrastructures appear to be less relevant for LLs oriented to the public, but in some cases, e.g., IT, specific infrastructures may be needed, in case sensors are deployed in the territory.
- **SENSORS:** sensors and IoT devices are hardware oriented to sense its environment in terms of parameters such as temperature, weather conditions, etc. Though sensors are mentioned solely by GR, as a means to monitor vineyards, these may be relevant also for IT, as they can be deployed to monitor the status of rivers and streams.

Table 6: ICT components (or technologies) identified by LLs.

LL	Technologies
IT	**E-mail:** this component is used by citizens to send notifications to the consortium. **[APPLICATION]** **Smartphone:** this component is used for sending notifications, taking photos of the site, send the report to the responsible technical staff. **[GENERAL-PURPOSE-HARDWARE]** **Messaging Apps (e.g., WhatsApp):** this component is used to send notifications and photos of the need for intervention in real-time from the field. **[APPLICATION]**

	Web Apps managing the notification system: This component is used to facilitate the interaction between all actors of the system. **[WEB-PORTAL]** **Web App URBI:** this component is used to store data of the Consortium Toscana Nord. **[WEB-PORTAL] [DATABASE]** **Public climate databases (e.g., Copernicus):** This component could be added to the ones currently used to include the use of climatic data. **[DATABASE]** **Digital signature:** this component is used by the executive manager and the President of the consortium to approve the responses for the citizens. **[APPLICATION]** **Databases of the Consortium:** those components could potentially be connected to improve their interoperability and connect data from environmental monitoring with data from land management and economic data on the use of resources. **[DATABASE]** **Environmental databases:** those databases are often managed by the Regional Administration (e.g., ARPA) or specific research institutes and could be better organized and made available to the technical staff of the Consortium Toscana Nord. **[DATABASE]** **Dashboard:** application to visualise the data coming from the citizens and from the other platforms. **[APPLICATION]**
DE	**Web Application:** publicly accessible with individualised accounts. This supports the goals of offering events, activating participants, and documenting the event based on information collected with cameras and smartphones. The application includes: a messaging function; a set of individual user profiles; event profiles; a matchmaking functionality to support matchmaking between event organisers and potential participants and supporters; a suggestion feature, which can be enabled/disabled, to support feedback from event participants; a feature to notify interest for a certain event; geo-tagging of the event location to facilitate the navigation towards the event. **[WEB-PORTAL] [APPLICATION][APPLICATION-COMPONENT]** **Devices:** users' mobile and stationary devices on which the web application and geo-functionality are used. **[GENERAL-PURPOSE-HARDWARE]** **Existing Interfaces:** online services already established in the region to advertise the events. **[WEB-PORTAL]** **Camera or smartphone**: this supports the goal of documenting the events when these take place. **[GENERAL-PURPOSE-HARDWARE]** **Virtual interaction spaces:** posts, chat room, groups, forums that facilitate the interaction among actors. **[APPLICATION] [WEB-PORTAL]**
AT	**GNSS:** GNSS is the Global Navigation Satellite System which enables global positioning of objects. It is used to collect the positioning data of trees, from the location of the felling along the route of transport to the processing facility. **[INFRASTRUCTURE-SERVICE]**

	[SPECIFIC-PURPOSE-HARDWARE] **Satellite data:** this component is used to verify tree extraction in a specific location in a given canopy. The purpose is to visually verify the logging of single trees. **[DATABASE][APPLICATION]** **Tagging device:** this component is used to tag a single with a unique identification, to allow the identification of each roundwood. **[SPECIFIC-PURPOSE-HARDWARE]** **Scanning device:** this component is a device capable of automatically scanning trees at processing facilities at the handover/arrival. **[SPECIFIC-PURPOSE-HARDWARE]** **Cloud infrastructure:** this component is a digital environment where digital information is stored, combined, and exploited. **[INFRASTRUCTURE-SERVICE]** **Mobile broadband:** this component is a digital technology for the transmission of data making use of mobile frequency. **[SERVICE]**
GR	**LoRa WAN Gateway:** The LoRa WAN gateway is used as a router to receive information from the field sensors. **[SPECIFIC-PURPOSE-HARDWARE] [INFRASTRUCTURE-SERVICE]** **On Field Agricultural Sensors:** Sensors serve for the regular and automatic agricultural measurements and enable the processing of data to useful information for the grow and needs of grape cultivation as well as the warning of infections from pests and diseases. **[SENSORS]** **Profiling & tracing modules:** IoT, Isotopic and nutrition profile, tracing modules provide information and continuous monitoring capabilities on geospatial data, satellite imagery, nutritional data of the grapes and wines as well as date-time-location information of the stock in supply. **[APPLICATION]** **Portal for data handling and display:** Serves in gathering and input information about weather conditions, physicochemical properties and geospatial imagery of the fields and soil. User's data are stored in a cloud-based database so users can access their data anytime. Each farmer can input information and soil analysis data for more than a single field. **[WEB-PORTAL] [DATABASE][INFRASTRUCTURE-SERVICE]** **Consumer Application:** Extend the features and services of wine producers beyond the retailer's 'shelf' by providing consumer information, rating, and feedback capabilities. **[APPLICATION]**
SCO	**Simulated croft environment:** gamification helps to entertain and engage visitors to the digital platform. **[APPLICATION-COMPONENT]** **360-degree footage**: Bespoke visual footage helps to engage participants and create interactive context. **[APPLICATION-COMPONENT]** **Embedded resources:** give details of the contextual environment, lasting resources, why

	the training is important, details of use. **[APPLICATION-COMPONENT]** **Embedded icons:** provide URL link to training opportunities, date/time/place/contact details, how to register. **[APPLICATION-COMPONENT]** **Embedded survey link** provides a link to the survey that can provide feedback about the opportunities. **[APPLICATION-COMPONENT]**

4.3 Limitations of Existing Solutions

Table 7 lists the identified limitations of existing solutions for each LL. Limitations can be grouped into the following main categories: limitations that affect the process, related to the quality of information, affecting people, or limitations of existing technologies. All these limitations are concerned with aspects that are expected to be solved with the envisioned system.

Process:

- TIME: processes can be time consuming, especially when activities are performed manually.
- PLANNING: the absence of aggregated information makes difficult to have the data that can allow decision-maker to better plan for the activities of the process.
- CENTRALISED DECISIONS: without means to collect information from the community, decisions are often taken top-down, which means that processes and goals follow the institutional agenda rather than the needs of citizens.
- EVALUATION LIMITATIONS: without means to collect feedback from people who participate in the process, evaluation of the outputs of the processes is limited.
- MISSING ACTIVITIES: some activities (e.g., full tracing, geolocalisation, cf. AT), which would be needed to better plan processes are not performed due to the absence of appropriate supporting technology.
- MARKET: some large market opportunities are missed due to the absence of appropriate technology to guarantee the quality of the products of the process (either concrete products, e.g., wine, GR, or services, e.g., events, DE), and to make appropriate and timely marketing.
- LEGALITY: lack of technology to monitor the process and guarantee that certain norms are respected leads to the possibility of frauds (e.g., the case of wood traceability in AT).
- LACK OF CONTROL: without data and information about the process, there is limited control on the process itself, and therefore limited possibility to improve it.
- LACK OF TRANSPARENCY: without data and information about the process, there is a lack of transparency about the quality of products (e.g., wine in GR). This leads to a lack of trust by consumers.

- PRODUCT QUALITY: without information about the process of production, there is less uniformity in the products of different vendors, and the overall quality of the product decreases, as the case of GR, where different vineyards in the same area ends up producing different wines.

Information:

- LACK OF INTEGRATION: without appropriate technology to centralise the data collection process, we have information that is not sufficiently integrated and uniform, thus affecting decision making.
- LACK OF INFORMATION: without appropriate technology to collect certain information (e.g., about product tracing in AT), certain activities of the process are not possible.
- INFORMATION TRUST: if information comes from one source only (e.g., citizens for IT), this could be biased, and technology can compensate with a second source to ensure greater trust.
- INFORMATION OVERLOAD: information about the process can increase in a way that cannot be managed manually (e.g., feedback from citizens in IT), and technology is needed to filter and prioritize this information.
- UNSTRUCTURED INFORMATION: when information comes from people, it is often in natural language, and it is therefore unstructured and hard to manage. Technology can help to complement this information with structured data, e.g., coming from sensors and existing databases (IT).
- INFORMATION SHARING: without appropriate technology, e.g., web portals, forum or other direct channels with central authorities, information is hard to share, therefore affecting process knowledge.

People:

- EXCLUSION: democratic technology (e.g., forums, event managers for DE) can help to give voice to people who are otherwise excluded from the decision-making process.
- MISSING OPPORTUNITIES: some opportunities to provide a better quality of services and products are missed without the technology, as in DE, where certain events do not take place due to the absence of a shared and public portal.
- LIMITED INVOLVEMENT: without democratic technologies, involvement of citizens in the process of decision-making is limited.

Technology:

- LIMITED USABILITY: limited usability of current technological solutions requires improved solutions, as for the case of AT systems for tracing.

- LIMITED CONNECTIVITY: limited connectivity available in certain areas, as well as the need to collect information from sensors, require improvements in terms of communication technology, as for the case of GR.

Table 7: limitations of present processes in LLs, to be overcome thanks to co-designed solutions (use cases).

LL	Limitations of Existing Solutions
IT	**Not informed planning of interventions:** the annual planning of maintenance works is based on the previous maintenance works activities without a direct connection to climate and precipitation events. **[PLANNING]** **Qualitative sources of alerts:** alerts from citizens and public administrations are the main source of information that contribute to define areas with a higher hydrogeological risk where maintenance works are needed. **[UNSTRUCTURED INFORMATION]** **Limited integration of data:** different institutions are responsible for environmental monitoring data collection and data are not always integrated. **[LACK OF INTEGRATION]** **Unavailability of data:** Data on extreme climatic events on a specific area are not always available or easy to be collected and make the process of identify responsibilities more complex. **[LACK OF INFORMATION]** **Distributed responsibilities:** different institutions are responsible for environmental monitoring data collection and data are not always integrated. **[LACK OF INTEGRATION]** **Citizens as the main information sources:** citizens are the main source of information on the state of the art before and after a specific climatic event in a specific location. **[INFORMATION TRUST]** **Problem of data management:** several reports are expected to be received based on the monitoring carried out by farmers. **[INFORMATION OVERLOAD]** **Time consuming processing of information:** notifications received from citizens are manually processed and evaluated **[INFORMATION OVERLOAD] [TIME]** **Complex steps for process support:** the process for assignment of work is complex, time consuming and requires the involvement of multiple parties, with possible bottlenecks. **[PROCESS COMPLEXITY]**
DE	**Limited public discussion of events:** topics of possible events in the region are only seldomly discussed publicly **[INFORMATION SHARING]**

	Exclusion of individuals: individuals who are not part of groups and institutions are not given the opportunity to develop topics for events **[EXCLUSION]** **Missing opportunities:** potential ideas get lost or are not realised **[MISSING OPPORTUNITIES]** **Top-down definition of events:** The region's event programme is defined from institutional organisation **[CENTRALISED DECISIONS]** **Topic of interest driven by institutional agenda:** Topics are following the agendas of institutions **[CENTRALISED DECISIONS]** **Limited event options:** the region's programme is not sufficiently diversified. **[MISSING OPPORTUNITIES]** **Facility identification:** Finding appropriate facilities to support the event requires knowledge (opportunities or intermediaries). **[LACK OF INFORMATION] [PLANNING]** **Time consuming facility organisation:** Organising an appropriate facility can be time consuming **[TIME]** **Limited overview of facilities:** An overview of available facilities in which events can be performed does not exist **[LACK OF INFORMATION]** **Limited set of event organisers:** Events are organised always by the same institutions and experts. **[CENTRALISED DECISIONS]** **Limited ways for finding organisational support:** experts and supporters to help the organisation of an event are hard to reach. **[LACK OF INFORMATION]** **Event marketing weaknesses:** marketing an event is a tedious activity, and it is hard to target appropriate subjects. **[MARKET]** **Absence of feedback:** the absence of feedback about events do not facilitate their adjustment. **[LACK OF INFORMATION]** **Unknown Event Attendance:** organisers of events cannot estimate the number of participants in advance. **[LACK OF INFORMATION]** **Unknown Event Interest:** Organisers cannot evaluate the public's interest in an event in advance. **[LACK OF INFORMATION]** **Hard Planning:** Without information on the number of participants, events are hard to plan. **[PLANNING]**

	Hard Event Localisation and Navigation: it is complicated to locate and navigate to an event, which leads to decreased participation. **[LACK OF INFORMATION]** **Limited evaluation:** evaluation of events take place through diverse platforms, and this create a need to homogenise and export data. **[EVALUATION LIMITATIONS]** **Biased evaluation:** evaluation takes place internally, and it is not public, and therefore only selected, and possibly biased subjects contribute to the event evaluation. **[EVALUATION LIMITATIONS]** **Limited access to evaluation:** the evaluation is not made public, so people do not see how a certain event is judged by the participants. **[EVALUATION LIMITATIONS]** **Top-down event documentation:** events cannot be documented by citizens and participants but only by organisers, and this requires extra time, and limited documentation. **[CENTRALISED DECISIONS]** **Press coverage delayed:** press coverage of events is published late, diminishing the visibility of the event. **[TIME]**
AT	**Late tagging:** Conventional tagging is seldomly performed at the location of the felling. **[LACK OF INFORMATION] [MISSING ACTIVITIES]** **No geolocalisation:** Traditional tagging methods do rarely include the transmission of the geolocation. **[LACK OF INFORMATION] [MISSING ACTIVITIES]** **No tagging-based traceability:** Current tagging methods do not focus on the purpose of traceability but are rather used for internal organizational purposes. **[MISSING OPPORTUNITIES]** **Limited usability of tagging systems:** Current tagging systems tend not to be user-friendly. **[LIMITED USABILITY]** **No tracing of tree route:** tracing of trees at each intermediate processing location is not performed. **[MISSING ACTIVITIES]** **Paper-based procedures:** The current procedure is heavily based on paper and online documents, which are prone to forgery. **[MISSING ACTIVITIES] [LEGALITY]** **Time consuming documentation:** the current approach is time consuming **[TIME]** **Time consuming verification:** the current approach for verification by the national forestry agency is paper-based and time consuming **[TIME]**

	Hard to verify legal compliance: the large number of paper-based documents and their manual verification make it difficult to verify legality **[LEGALITY]** **Limited use of advanced technologies for verification:** The current approach does include digital technologies for verification purposes only to a minimal extent; no technologies e.g., satellite data for verification are used. **[MISSING ACTIVITIES]** **No centralised information:** with regard to the case of the European timber market, there is no central cloud infrastructure containing all relevant information. **[LACK OF INTEGRATION]**
GR	**Lack of central registration of fields:** the lack of registration of the growing fields hamstrings the organised wine production in a regional scale. **[LACK OF INTEGRATION]** **Lack of tracing:** missing opportunity to acquire valuable information to associate the local geographical characteristics with the local wine product. **[MISSING ACTIVITIES] [MISSING OPPORTUNITIES]** **Limited connectivity:** the current scale of remote coverage is very small compared to the capacity of the region. The LoRa transmission has the capacity to cover more than 200 sensors that could be placed in strategic locations of interest. **[LIMITED CONNECTIVITY]** **Limited involvement of farmers:** the lack of on-demand data capturing from grape growers is a missing feature that could enrich the data exchange and incentivise the involvement of farmers and agronomists with new digital tools. **[LIMITED INVOLVMENT]** **Suboptimal grape terroir:** the absence of a common terroir identification strategy leads to grape yields that are placed in growing fields that are not spatially or geologically suitable. **[PRODUCT QUALITY]** **Inconsistent production:** wine production is not consistent in terms of quality since annual yields differ due to discrepancies in weather condition or cultivation processes. Cultivation routines vary, impacting the overall consistency of the wine production. **[PRODUCT QUALITY]** **Lack of access to grape growing information:** wine makers that are not also growers do not have access to grape growing information **[LACK OF INFORMATION]** **Unstructured process:** information is mostly processed in an unstructured manner from grape cultivation to winemaking **[UNSTRUCTURED INFORMATION]** **Lack of information for consumers:** the local wines produced are not being accompanied by information such as variety, size, quality certificates, harvest and post-harvest practices, photographs. **[LACK OF INFORMATION]** **Lack of quality control:** lacking quality controls of food safety over maximum residue limit and pesticide usage **[PRODUCT QUALITY]**

	Limited logistic planning: Missing logistics planning and real-time tracking of wine lots in the supply chain. **[PLANNING]** **Lack of access to larger markets:** without tracing information, one cannot show ISO certification of the process, and this limits the access to a wider market. **[MARKET]** **Lack of control of the supply chain:** producers and winemakers have less information and agency over their products in the supply chain. **[LACK OF CONTROL]** **Lack of transparency for consumers:** lack of legitimacy, transparency, control, and limited extent of information the consumers receive. **[LACK OF TRANSPARENCY]** **Lack of feedback to improve products:** producers do not benefit from an established feedback loop with the consumers, lack of opportunity to make changes on the product or maintain quality standards that reflect positively In the market. **[EVALUATION LIMITATIONS]** **Information bias towards producers:** the feedback received is very limited and coming from people having personal relationships with the producers, and this factor affects the information bias. **[EVALUATION LIMITATIONS]**
SCO	**No one place to look for training:** there is currently no centralised portal to look for training opportunities **[LACK OF INTEGRATION]** **Training opportunities missed:** without a centralised portal, crofters can miss opportunities for training **[MISSING OPPORTUNITIES]** **Low turnout:** results are poor, due to missing opportunities for training [**PRODUCT QUALITY]** **Time consuming:** the activity of searching for training is based on relationships and it is time consuming **[TIME]** **Exclusion of subjects:** some subjects who do not have the right contacts are excluded from the training opportunities **[EXCLUSION]** **Inaccurate information:** limitations exist in terms of evaluation and feedback about the training courses **[EVALUATION LIMITATIONS]**

4.3 Proposed Solutions

In Table 8 we report the summary of the proposed solutions to address the limitations listed in Section 4.2 and summarised in Table 7.

Table 8: proposed solutions to overcome the present limitations as in Table 7.

LL	Proposed Solution
IT	The proposed solution is a platform that integrates notifications from citizens, coming from diverse sources, e.g., emails, WhatsApp, with historic and current meteorological data. The platform also supports the overall ordinary planning and monitoring of interventions, so that the users can see the timeline, and associate interventions and unexpected meteorological events. The platform also integrates the assignment of supervision by technicians and the assignment of works to private subjects. The platform also supports the monitoring of the interventions by the president of the consortium.
DE	The proposed web application facilitates citizens, organisations, and institutions in organising events. The application supports different functionalities, namely: definition and organisation of a new event; a messaging function to support interactions between users and organisers; a set of individual user profiles; event type profiles; a matchmaking functionality to support matchmaking between event organisers and potential participants and supporters; a suggestion feature, which can be enabled/disabled, to support feedback from event participants; a feature to notify interest for a certain event; geo-tagging of the event location to facilitate the navigation towards the event.
AT	The proposed solution is a tracing and verification system for tree logging. The technology includes a mobile tagging device, a scanning device at the wood processing facility, GNSS technology for the registration of the geolocation of a tree, satellite data for verification and a cloud infrastructure for a centralized storage of relevant information, which allows to query for data. Transmission of data is based on mobile technologies. The functionalities supported by the system include tagging, registration, combination of information about traceability, and verification of the information for legal compliance.
GR	The proposed solution consists in a platform that collects information from farmers, wine makers, and in-field IoT sensors, which are connected with a LoRaWAN gateway, to enable gathering and analysis of data across the wine supply chain, starting from grape producers and moving towards vineyards, wineries and finally wine consumers. The tracing system is supported by the blockchain technology. The system aims to enhance the traceability and security aspects of the products (wines), as well as increase resilience in the wine value chains while strengthening the position of farmers and wine producers in the market.
SCO	DigiCroft represents a centralised hub for accessing different training courses normally distributed in the web, and hard to reach. DigiCroft is a web application, which provides a 3D user interface in which in which a croft environment is shown. The user can navigate the environment, and explore the different objects present in the environment (e.g., windmills). The user interface includes embedded icons associated to objects in the 3D environment that allows the user to access and register to relevant training courses related to the specific objects. The training courses are associated to specific webpages, in which registration for the courses is available.

Figures 6-10 provide the graphical representation of the proposed systems, following the notation defined in the meta-model presented in Fig. 2.

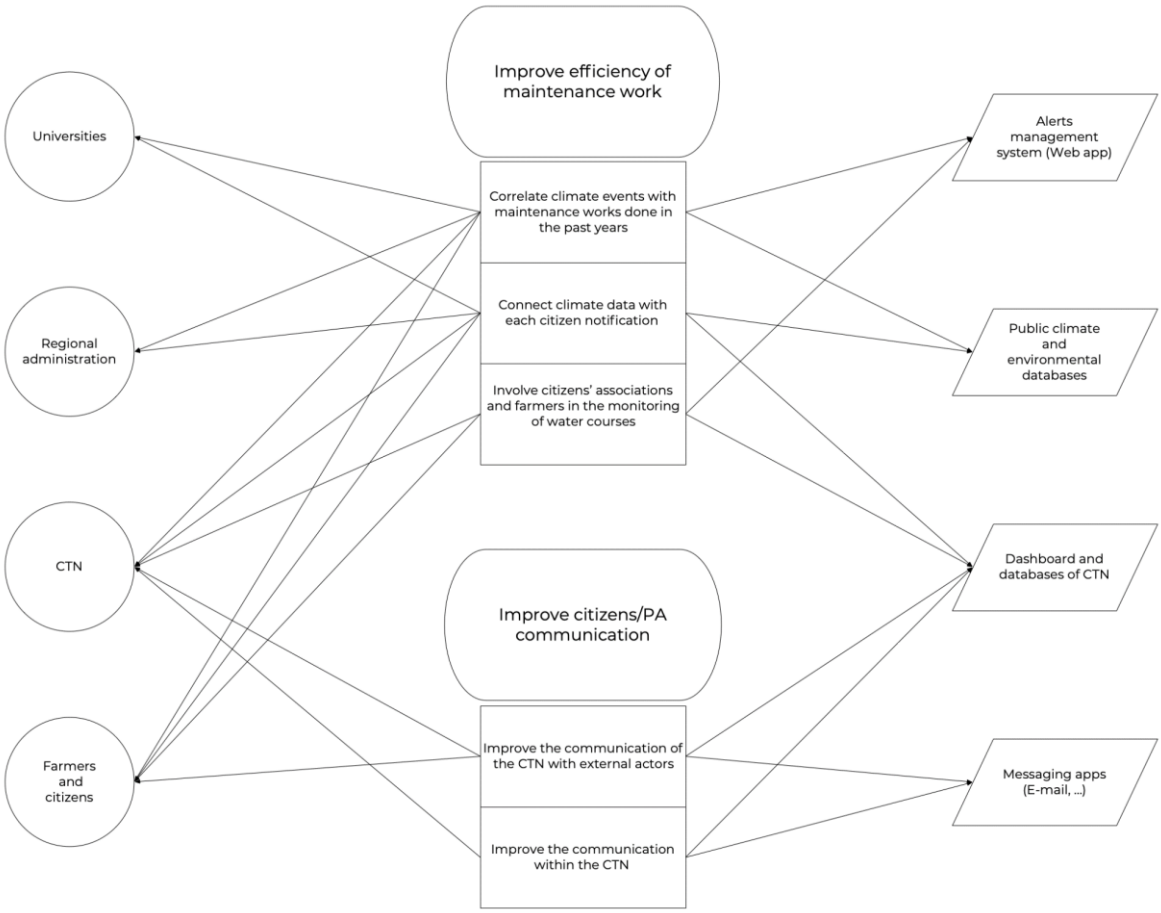


Figure 6: model of the IT system (following the notation in Fig. 2).
Drivers, barriers, impacts, and task descriptions are not added to avoid confusion.

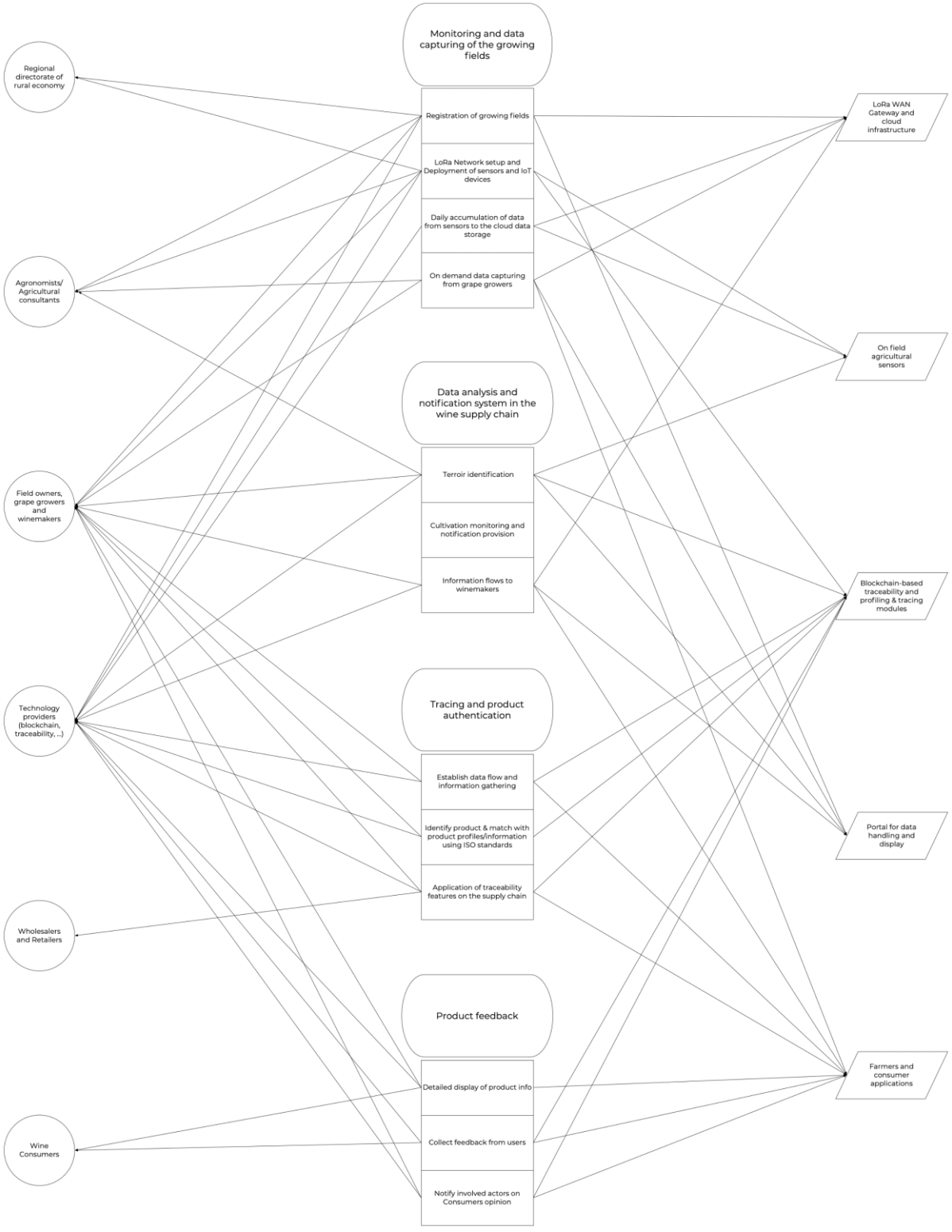


Figure 7: model of the GR system (following the notation in Fig. 2).
Drivers, barriers, impacts, and task descriptions are not added to avoid confusion.

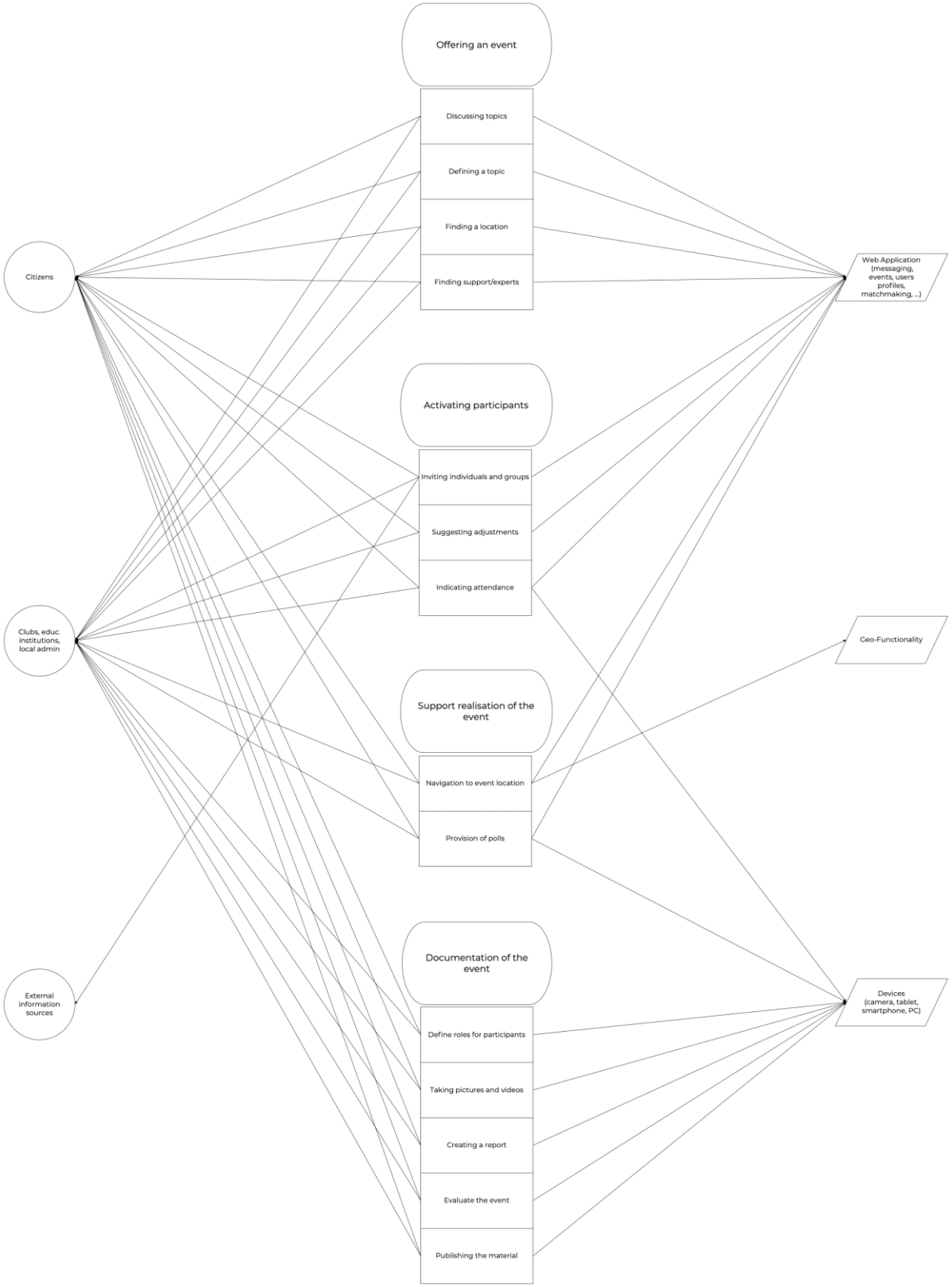


Figure 8: model of the DE system (following the notation in Fig. 2).
Drivers, barriers, impacts, and task descriptions are not added to avoid confusion.

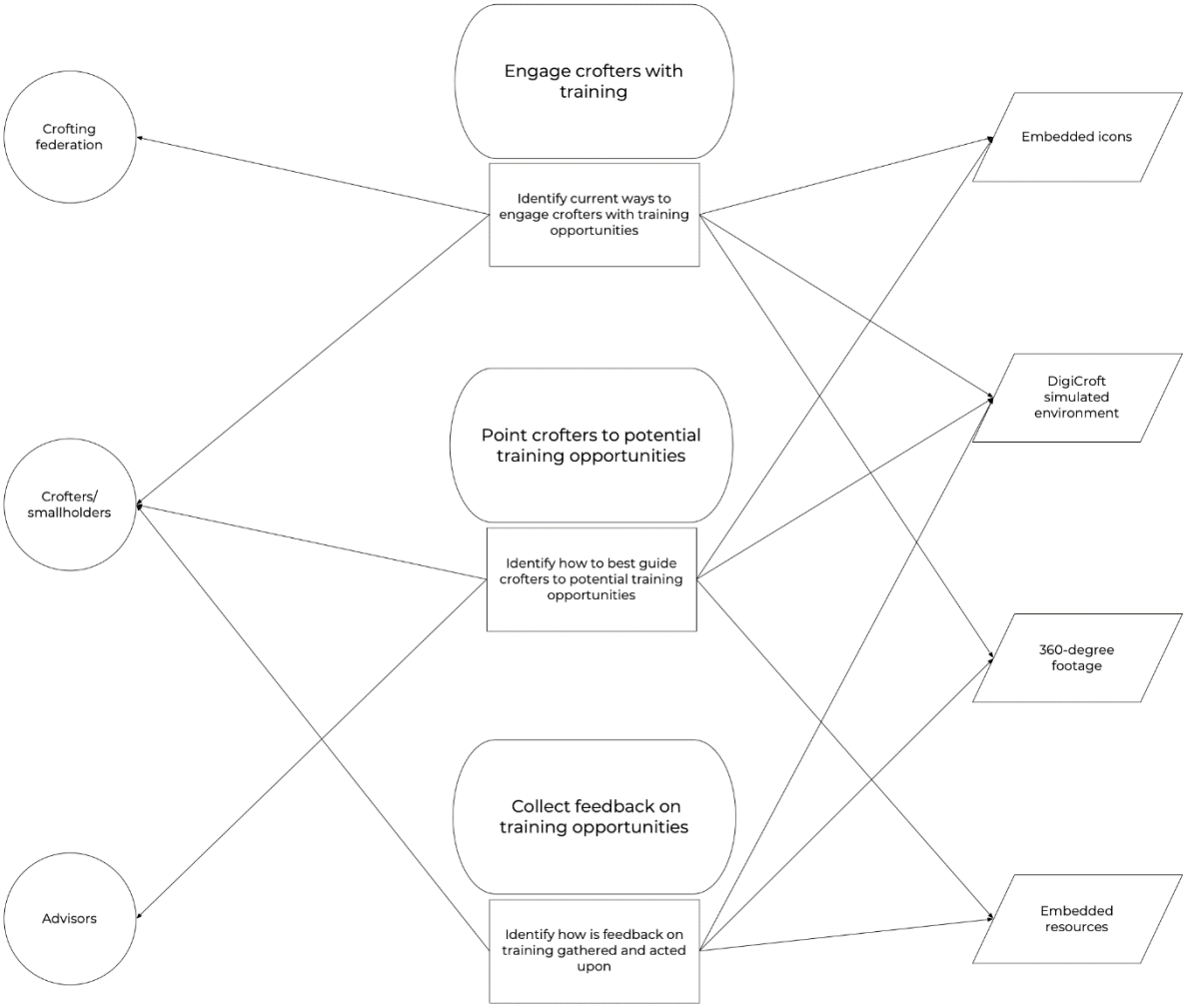


Figure 9: model of the SCO system (following the notation in Fig. 2).
Drivers, barriers, impacts, and task descriptions are not added to avoid confusion.

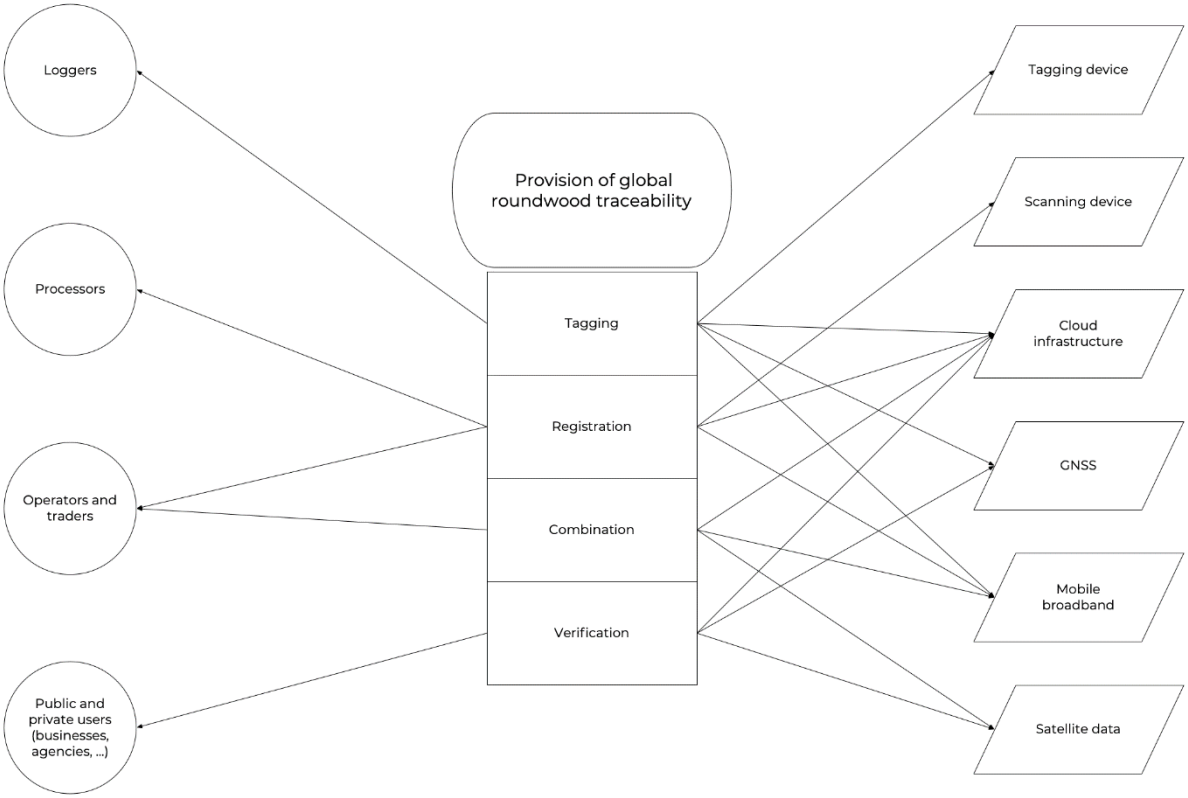


Figure 10: model of the AT system (following the notation in Fig. 2).
Drivers, barriers, impacts, and task descriptions are not added to avoid confusion.

5. Challenges and Opportunities: Drivers, Barriers, and Impacts

After defining the solutions herein described in Section 4, Living Labs also carried out the analysis of challenges and opportunities that the co-designed digital tools may introduce if they were to be developed and used. The aim is in identifying what are defined as drivers, barriers, and impacts having in mind the goal(s) (see Table 4) that the digital tools meet in the context of the Living Lab.

We recall that the methodology used for this analysis builds on two DESIRA scientific publications [10,11]. In particular, ref. [11] defines four domains (or dimensions), i.e., *economic*, *environment*, *governance*, and *social*, which have been used as main categories in the use case workshops.

The concepts of barriers, drivers, and impacts are presented in [10] and recalled in the following. **Drivers** include goals of some stakeholders, for example the need to improve wheat quality required by farmers, but also other higher-level aspects, for example the funding from institutions to support specific technologies. **Barriers** include obstacles in KAOS t*erms* [12], intended as elements preventing the achievement of a specific goal, but also more structural impediments that hamper the introduction of the digital technology as a whole in the given context. For example, the difficulty of farmers in interacting with the novel technology, or the regulatory problems related to the use of drones (unmanned aerial vehicles). The concept of **Impact** is analogous to that already considered in [13,14], and is intended as the expected effect that the digital technology can have from a sustainability standpoint, and thus in the mid to long-term. The impact can be positive, as, e.g., reduction of manual labour, but also negative, for example due to the exclusion of small farmers that cannot afford the technology.

Figure 11: elicitation of drivers, barriers, and impacts in the DE case.

5.1 Impacts

The first step is to identify potential impacts in the aforementioned four dimensions. Such analysis is repeated by each LL for every goal defined in the use case. The question to be answered is:

If the system were to be developed and used, which impacts do you foresee in both the short and the long term?

More specifically, the interest is in the impacts of each defined goal (or task) on the four dimensions above, as presented in Tables 9-13. The impacts in use in this part are drawn from Table 5 in [10], and can be divided into:

- *socio-cultural impacts*: related to quality of life, education, and the sense of being part of a community;
- *socio-economic impacts*: related to labour, finance, management, and market;
- *socio-political impacts*: related to institutions and institutional matters, and to data-related topics (ownership, transparency, compliance with regulations through data evidence, management, trust, value);
- *environmental impacts*: as reduction of impact on the environment or conversely in terms of improved sustainability.

Those categories have been re-used to code the impacts described by the Living Labs.

It is worth noting that there is a strong dominance of positive impacts with respect to negative ones (in red in Tables 9-13). For actors, being part of the design process of a digital tool since the very beginning likely generate a sense of trust and reinforce the value of the collective experience in this process. The perception of plausible negative impacts is reduced to a minimum, and the presence of different stakeholders in the group further minimise the possibility that one or more classes of potentially impacted stakeholders distrust the tool or feel excluded from its use or the way it works.

The categories of considered impacts per Living Lab show noticeable differences among the 5 cases according to the use case statement (i.e., the overall objective):

- the IT case has a strong *managerial* nature, accompanied by *financial* and *institutional* type impacts. This can be explained by considering that the main actor in the Living Lab is the Consortium Toscana Nord (CTN), i.e., the public entity deputed to the ordinary management of watercourses and land in the regional area, thus with a clear interest of digital tools that can provide support in such a task.
- the DE case revolves around the *community* and *education* impact types. The use case statement immediately puts forward the need of fostering meetings and activities within a rural community, dispersed over a rather large area, which may require careful attention in the design of the digital tool to also include actors with lower digital skills.
- the AT case has a strong *institutional* nature. The envisioned tool - already under development by BeetleForTech, a start-up involved in the LL - is designed as a service to be offered to institutional entities to contrast illegal logging and the use of related products (such as

roundwood). The *institutional* nature couples with the need to protect endangered tree species (*environmental*) thanks to the improved traceability of wood products.

- the SCO case considers mostly *educational* type impacts given the purpose (training) of the proposed system. The type of activities potentially offered in the future through the tool may have impacts on the businesses run by participants (crofters mainly) thanks to novel ideas and opportunities that training may provide. Being envisioned as a one-stop-shop making use of gamification to entertain whilst informing viewers, the proposed system design carefully considers the needs of participants with potential low digital skills.
- the GR case covers a wider range of impacts when compared with other cases; even though there is a more recognisable presence of *financial*, *market*, and *data*-related impact types, *labour* and *education* impact types are considered as well. This can be explained by recalling the objective of setting up a system to gather data across the wine supply chain for the purposes of improved traceability, quality, and security of the products, providing useful data to the farmers and wine producers. The actors in the Living Lab are mainly farmers and wine producers with an interest in digital tools that can improve their position on the market thanks to data collected at each step of the supply chain, but also aware of the impacts that such a system may have on how their labour is currently organised, and on the digital skills (education) they may need to both "understand" collected data and leverage those in their own favour. The cost of the initial investments is highlighted as a negative impact.

Table 9: impacts per goal of the IT use case.

Living Lab	Goal	Economic	Social	Governance	Environmental
IT	*1. more efficient maintenance work*[1]	reduced number of legal claims against CTN for lack of maintenance and related expenses [**MANAGEMENT, FINANCIAL**]. increase in ordinary maintenance actions reduces the need for extraordinary ones [**MANAGEMENT**].	more interaction with public/private research activities [**INSTITUTIONAL**].	better coordination among institutions holding environmental monitoring data [**ENVIRONMENT**].	improved territory management [**ENVIRONMENT, MANAGEMENT**]. reduced hydrogeological risk [**ENVIRONMENT**].

[1] A technical impact has been added: *improved integration between data sources*.

		optimisation in the use of resources [**MANAGEMENT**]. more funding opportunities [**FINANCIAL**]. increase in costs associated with technology management [**FINANCIAL**].			
	2. better communication between citizens and PA	improved organization of the work and related workflow [**MANAGEMENT**].	involvement of farmers and citizens in land monitoring [**COMMUNITY**, **ENVIRONMENT**]. increased sense of participation [**COMMUNITY**].	management process more agile [**ENVIRONMENT, MANAGEMENT**].	reduced hydrogeological risk [**ENVIRONMENT**].
	3. larger involvement of citizens and farmers in monitoring water courses	fewer field inspections by technical staff [**MANAGEMENT**].	involvement of farmers and citizens in land monitoring [**COMMUNITY, ENVIRONMENT**]. increased sense of participation [**COMMUNITY**].	clearer relationships and responsibilities among actors [**INSTITUTIONAL**].	improved territory management [**ENVIRONMENT, MANAGEMENT**]. reduced hydrogeological risk [**ENVIRONMENT**].

			reduced presence of CTN staff on the territory [**COMMUNITY**].		

Table 10: impacts per goal of the GR use case.

Living Lab	Goal	Economic	Social	Governance	Environmental
GR	*1. data collection from fields*	initial investment to set up the system, from sensors to storage [**FINANCIAL**].	development of new skills [**LABOUR**]. increased knowledge [**EDUCATION**].	availability of data to support regional planning [**DATA, MANAGEMENT**].	availability of data to support better land use [**DATA, ENVIRONMENT**]. safeguard of flora and fauna [**ENVIRONMENT**].
	2. data analysis and notification	initial investment for service provision [**FINANCIAL**].	development of new skills [**LABOUR**]. increased knowledge [**EDUCATION**].	availability of data for better synergies among primary and secondary business actors [**DATA, MARKET**].	reduction of inputs and waste in the fields [**ENVIRONMENT**]. sustainable water management [**ENVIRONMENT**].
	3. tracing and authenticating products	increased production value [**MARKET**]. competitive advantage [**MARKET**].	greater transparency and legitimacy to local business practices [**MANAGEMENT,**	data availability on market flows to support analysis [**DATA, MARKET**].	optimisation of logistic services to lower their footprint [**ENVIRONMENT, MARKET**].

			INSTITUTIONAL].		
	4. feedback services	increased market value thanks to more detailed information on products [**MARKET**].	highlighting social responsibility of local businesses [**COMMUNITY, ENVIRONMENT, MARKET**].	producers' agency over their products thanks to customers' feedback [**MARKET**]	periodic access to grape and wine data to support environmental -friendly practices [**ENVIRONMENT, MARKET**].

Table 11: impacts per goal of the DE use case.

Living Lab	Goal	Economic	Social	Governance	Environmental
DE	*1. offering events*[2]		bring people together [**COMMUNITY**]. increased number of opportunities [**COMMUNITY, EDUCATION**]. risk of system misuse [**COMMUNITY**].	promotion of political campaigns and events [**MARKET**].	space for discussion on environmental topics [**ENVIRONMENT, EDUCATION**]. risk of promoting too large events [**ENVIRONMENT, COMMUNITY**].
	2. activating participants	positive effect on restaurants/bars close to events [**MARKET**].	change in attitudes **[COMMUNITY]**. pulling effect (also intergenerational)		meetings arrangements to raise environmental awareness [**ENVIRONMENT, EDUCATION**].

[2] a 'technological' impact has been added: *use of the system opens to future refinements*.

			[COMMUNITY]. better planning through feedback on past events **[COMMUNITY]**. creation of regional knowledge **[EDUCATION]**. easiness of planning **[COMMUNITY]**. improved cohesion among members **[COMMUNITY]**. feelings of success and confirmation **[COMMUNITY]**.		
	3. supporting events	knowledge of new software tools [EDUCATION]. community more attractive for outsiders [**COMMUNITY, MARKET**]. better networking	community more attractive for outsiders **[COMMUNITY]**. networking and closeness among the community members (also intergeneratio	'getting into conversation' is partly digitised [**COMMUNITY**]. future governmental /federal entities for the digital transformatio n can build on	

		within the community [**COMMUNITY**].	nal) **[COMMUNITY]**. discovery of new places for/during meetings **[COMMUNITY, QUALITY OF LIFE]**. risk of further marginalisation for people not invited **[COMMUNITY]**.	such tool [**INSTITUTIONAL**].	
	4. documenting events	lower barriers to holding events [**FINANCIAL**]. area/region getting more visible from outside [**MARKET**].	increased participation in events, also of young people **[SOCIAL]**. organization phase is recorded/reported [**COMMUNITY**]. likely more cited by media [**COMMUNITY**].	likely more cited by media [**COMMUNITY**]. area/region getting more visible from outside [**MARKET**].	'data garbage' [**ENVIRONMENT, DATA**]. highlighting local events promoting environmental practices [**ENVIRONMENT, COMMUNITY**].

Table 12: impacts per goal of the AT use case.

Living Lab	Goal	Economic	Social	Governance	Environmental

AT	*1. global roundwood traceability*	contrast illegal logging [**INSTITUTIONAL**]. certification of wood products to market both legality and sustainability of products [**INSTITUTIONAL, ENVIRONMENT**].	contrast the loss of biodiversity to improve sustainability [**ENVIRONMENT**]. contrast organised crime [**INSTITUTIONAL**].	globally applicable solutions can support government efforts [**MANAGEMENT**, **INSTITUTIONAL**]. efforts can be more united [**MANAGEMENT**].	contrast to the loss of biodiversity [**ENVIRONMENT**].

Table 13: impacts per goal of the SCO use case.

Living Lab	Goal	Economic	Social	Governance	Environmental
SCO	*1. engage crofters with training*	improve skills, streamline production, save money [**MARKET**, **MANAGEMENT**, **FINANCIAL**].	expand networks, improve social skills [**COMMUNITY**].	engage with policy and regulations [**INSTITUTIONAL**].	improve environmental practices [**ENVIRONMENT**].
	2. point crofters to potential training opportunities	one-stop-shop [**EDUCATION, COMMUNITY**].	network building [**COMMUNITY**, **EDUCATION**]	policy and regulation awareness [**EDUCATION**].	
	3. collect feedback on training opportunities	targeted information to improve uptake and use of funding [**FINANCIAL**].		targeted funding [**FINANCIAL**, **INSTITUTIONAL**].	

5.2 Drivers

Once the impacts have been identified by the participants, the next step was reflecting on drivers and barriers, considering the same four dimensions used for the impacts analysis, and using the categories in Table 4 in [10], recalled in the following:

- *socio-cultural drivers*: practical demands (e.g., work flexibility, employment, reduction of isolation), and cultural tendencies (e.g., cooperation, solidarity, trust);
- *technical drivers*: quality (e.g., simple technology, reliability, efficiency), and service (e.g., connectivity, data);
- *economic drivers*: market (e.g., green company image, certification, competition), organisational (e.g., cooperation, intermediaries), business (e.g., better control, simplification of compliance policies), financial (e.g., decreasing technology cost, cost effectiveness), and labour (e.g., costs, shortages);
- *environmental drivers*: impact reduction (e.g., less fertilisers, less pesticides), and control (e.g., less food waste, improved animal welfare);
- *regulatory-institutional drivers*: restrictions (e.g., compliance, constraints, taxes), economic (e.g., funding, subsidies, incentives), education (e.g., training, mentorship, digital innovation centres), promotional (e.g., dissemination, promotion).

Similarly to the case of impacts, the question to be answered is:

What could be the (economic/social/governance/environmental) drivers facilitating the achievement of this goal?

The following considerations can be drawn based on the identified drivers, fully presented in Tables 14-18:

- the IT case builds almost entirely on the *organisational* type (well coupled with the *managerial* impact), followed by *financial* and *control* types. Indeed, the aim of the solution is to facilitate both the data collection from farmers and other stakeholders to better *control* the territory for the purpose of ordinary land management and the *organisation* of internal work to plan maintenance according to several criteria (urgency, available *financial* resources, and others). Especially on available economic resources, the need of additional funds (e.g., access to *incentives*) is another strong driver for such an application to be developed because it can improve the base of available statistical data (in terms of needed interventions, executed ones, needed resources, and so on in a given period) that CTN can use for the external communication of its activity, e.g., to clarify responsibilities in case of need, and to advocate for additional funding and an increasing political interest on environmental matters.
- the DE case has strong social drivers, especially *cooperation* to promote *inclusion* (impacting on the *community* sense). In additional, the need to digitally *promote* activities on the territory

for increased visibility, improved attraction of the region, a stronger and more united community, and to multiply opportunities thanks to events and networking activities therein.

- the AT case has varied drivers, covering the push from (or to) more decisive *regulatory* actions to contrast illegal logging (coupled with the *institutional* impact mentioned before in terms of providing both data and means to contrast illicit activities, and thus asking for a more controlled forestry sector), to inform and *educate* about the strong negative impacts in the case of large black markets, especially trading endangered tree species. Such a push may create *market* opportunities for certifications that may further drive the development of reliable and effective traceability systems.
- the SCO case builds on social drivers like *educational* and *promotional* ones. The idea behind the DigiCroft platform is linked to offering digital training opportunities for crofters and smallholders, thus having an impact on their possibility to improve digital skills and to gain from potential novel business opportunities that a digital and open platform may provide.
- the GR case confirms its strong *business* drivers because the participants' interest is in new opportunities that digital tools may bring in their field (wine production), also potentially opening a new digital *market*. Further to those, the strong potential recognised in *data* (and thus collection, storage, and analysis of those) is an additional critical driver highlighted by participants that may open multiple possibilities in different fields (e.g., reduction of agricultural inputs, decision support, improved 'green' image of products and farms backed by data). There is potential also in an improved and streamlined *organisation* that data may bring to the supply chain, even opening to the creation of alternatives in this regard.

Table 14: drivers per goal of the IT use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
IT	*1. more efficient maintenance work*	availability of data for defending actions in courts in case of legal actions claiming lack of maintenance [**REGULATORY**]. use of available	improved (timely, precise) feedback to citizens reporting the need for maintenance [**SERVICE, ORGANISATIONAL**].	political interest in getting more precise information from different sources [**ORGANISATIONAL, QUALITY**]. clearer responsibilities and roles	incremental damage because of more frequent extreme events [**CONTROL**].

		resources for digitalisation [**FINANCIAL**]. better exploitation of EO satellite data [**SERVICE**]. improved cost/benefit ratio of maintenance activities [**FINANCIAL**].		in case of hydrogeological damages [**REGULATORY**]. integration of citizens' alerts and objective data to better prioritise actions [**ORGANISATIONAL**]. political interest in the push for digitalisation of mountain areas [**IMAGE**].	
	2. better communication between citizens and PA	improved workflow within the CTN [**ORGANISATIONAL**]. use of available resources for digitalisation [**FINANCIAL**]. improved cost/benefit ratio of maintenance activities [**FINANCIAL**].	improved (timely, precise) feedback to citizens reporting the need for maintenance [**SERVICE, ORGANISATIONAL]**.	political interest in providing quick feedback to citizens (through CTN's activities) [**IMAGE**]. integration of citizens' alerts and objective data to better prioritise actions [**ORGANISATIONAL**].	incremental damage because of more frequent extreme events [**CONTROL]**.

				political interest in the push for digitalisation of mountain areas [**INCENTIVES**].	
	3. larger involvement of citizens and farmers in monitoring watercourses	use of available resources for digitalisation [**FINANCIAL**]. improved cost/benefit ratio of maintenance activities because of more participation [**FINANCIAL**, **INCLUSION**].	willingness of farmers and citizens to be a part of the land management process [**COOPERATION**].	political interest in getting more precise information from different sources [**ORGANISATIONAL**, **QUALITY**]. integration of citizens' alerts and objective data to better prioritise actions [**ORGANISATIONAL**].	reducing the impact of extreme climatic events because of more efficient ordinary land management [**CONTROL, IMPACT**].

Table 15: drivers per goal of the GR use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
GR	*1. data collection from fields*	increase production to the same levels of the past decade [**BUSINESS**].	improve the business profile of stakeholders [**BUSINESS**].	availability of data to support decisions [**ORGANISATIONAL, SERVICE**].	safeguard environment through monitoring [**CONTROL**].

	2. data analysis and notification	(re)assess land agricultural and market value [**MARKET**]. data as an asset available to regional actors [**MARKET**].	democratisation of data flows across the value chain [**SERVICE**].	increment multi-dimensional data collection from local entities for better decision support [**ORGANISATIONAL, SERVICE]**.	optimisation of land, soil, and water use for energy efficiency [**IMPACT**].
	3. tracing and authenticating products	link with thematic wine tourism [**MARKET**]. vineyard development as economical regional development [**MARKET, INNOVATION**].	PDO for local wines to improve the region's image [**MARKET**].	faster everyday's transactions [**MARKET**]. lower error rate due to manual intervention [**ORGANISATIONAL**]. traceability for more products [**BUSINESS**].	improve image and market position of wines by association with environmental standards [**BUSINESS**].
	4. feedback services	reach a share of the niche wine market [**MARKET**].	improve image and reputation in national/international markets [**MARKET**].	alternative platform to linear supply chains to supply other markets [**ORGANISATIONAL**].	products with a 'bio' image [**BUSINESS]**.

Table 16: drivers per goal of the DE use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental

DE	*1. offering events*	sponsoring opportunities [**PROMOTIONAL**]. attractiveness of the area/region [**PROMOTIONAL]**.	promotion of the system by local 'fans' wanting to host and go to events [**PROMOTIONAL**].		
	2. activating participants[3]		multiplier effect on participants number [**INCLUSION**]. easier planning through feedback [**COOPERATION**]. increased awareness of events and opportunities [**INCLUSION**].		
	3. supporting events	interest and support by administrations and associations [**PROMOTIONAL]**. more effective coordination among leaders, lowering their effort	community more felt among members [**COOPERATION**]. reward system [**INCENTIVES**]. networking with people at events brings more opportunities	impact on the digital policy agenda [**INSTITUTIONAL**].	digital planning may lower its impact (e.g., no printing) [**ORGANISATIONAL, IMPACT**].

[3] technological: usability and performance have a positive effect on attendance (and vice versa).

		[ORGANISATIONAL]. data (events, places, organization, …) released as open [**SERVICE**]. compliance with GDPR for sensitive data [**REGULATORY**].	[**COOPERATION**]. interest and support by administrations and associations [**SUPPORT**].		
	4. documenting events	opportunities for volunteers / young people to gain experience in public relations, news writing, etc. [**PROMOTIONAL**, **COOPERATION**]. hire of technology during events [**QUALITY**].	acknowledgement of efforts in setting up events [**INCENTIVES**].		digital documentation to save physical resources [**IMPACT**, **ORGANISATIONAL**].

Table 17: drivers per goal of the AT use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
AT	*1. global roundwood traceability*	new market opportunities thanks to certifications [**MARKET**].	increased awareness of positive effects of forests	'green' movements and parties in governments [**INSTITUTIONAL**].	strong concerns about loss of forests and biodiversity [**IMPACT**].

		contrast illegal activities [**REGULATORY**].	[**EDUCATIONAL**]. larger use of wood-based products [**MARKET**, **ENVIRONMENT**].		

Table 18: drivers per goal of the SCO use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
SCO	*1. engage crofters with training*	improve on business skills [**WORK**].	improve on networking skills [**EDUCATION**].	better understanding of policy and legislation [**EDUCATION**].	minimise impact [**IMPACT].**
	2. point crofter to potential training opportunities	better use of training opportunities; improved uptake of places in courses [**PROMOTIONAL**].	empowers people to engage [**EDUCATION**].		
	3. collect feedback on training opportunities	better use of resources, improved dissemination of information [**PROMOTIONAL].**		improved use of funding [**FINANCIAL**].	

5.3 Barriers

The final step of this phase is to anticipate potential barriers that may hinder the use of the co-designed digital tools. The discussion is, as before, strongly centered on the goals that each Living Lab

has set for the proposed tool, and even if some of the barriers can be generalised in wider settings, it is important to recall that the participants had in mind their context in this process.

As for the previous steps, the barriers are drawn from Table 3 in [10]:

- *socio-cultural barriers*: demographic (e.g., age, isolation), distrust (e.g., funders, regulators, technology), fear (e.g., dependency from technology, hidden costs, privacy), values (e.g., attachment to tradition), competence (e.g., poor education, knowledge, skills), complexity (e.g., regulations, technology);
- *technical barriers*: connectivity, dependability (e.g., poor reliability, efficiency), usability (e.g., in the field), scalability (e.g., limited functionalities);
- *economic barriers*: costs (e.g., of technology, maintenance, funding), scale (e.g., small markets, small businesses);
- *regulatory-institutional barriers*: data (e.g., ownership, governance), regulations (e.g., frequent changes, legal restrictions, inadequate grant schemes criteria).

Similarly to the case of drivers, the question to be answered is:

What could be the (economic/social/governance/environmental) barriers facilitating the achievement of this goal?

Also in this case, some considerations can be drawn from the barriers (fully presented in Tables 19-23) elicited in LLs, as we do in what follows:

- the IT case has several potential barriers due to internal and external causes. About external cause, the most important the LL considered is related to *competence* (in terms of digital skills) that actors should have to use the proposed system (e.g., farmers opening tickets in the digital tool asking for maintenance in an area instead of calling or sending messages to the CTN staff, or for CTN staff to handle new data sources). About internal causes, the reference is to the *complexity* of e.g., weighting procedures: in this regard, very interesting is the concern related to farmers' requests for maintenance work. Are those more urgent than citizens' requests because of their expertise? Or are farmers biased by economic factors[4]? At the same time, *costs* associated with new procedures may be related not only to technology development, but also to the new internal procedures to be put in place, to the need of properly handling received *data*, and to the staff's *competence* on those aspects.
- the DE case confirms, also in this case, its strong social nature, because the major reported barriers are related to *usability*, *demographic* factors, and digital skills (*competence*). A tool to foster events in the rural area by drawing together distant people is what the LL would like to achieve, but there is concern that, being it digital, its use may be limited in some cases (e.g., elderly people, or because of low digital skills) because of *competence*, but also because of *usability* concerns (e.g., its graphical interface and inner mechanisms), not to mention the

[4] Farmers may be asked to carry out maintenance work on behalf of CTN and thus get paid for it.

careful attention to be paid for users' *data* (e.g., putting online pictures taken during events, or the case of collected GNSS data).

- the AT case has a strong technological nature, thus its main barriers are related to *competence* (in terms of high-level digital skills that may be needed to fully leverage the tool), but also potential high *costs* for the system to be put in place (as a product or as a service for institutional actors). Its *complexity* (due to many interacting parts – i.e., satellite data, vision systems, database for fingerprinting-based recognition of wood, tagging activities in the field, etc.) can prove challenging for some actors, and the need for clear (and stricter, as advocated in the Living Lab) *regulations* is there, in order to allow public entities to enhance their controlling activities and thus fully leverage such a tool.
- the SCO case highlights *connectivity* as a strong barrier given the remote rural area under consideration. In fact, a digital training platform may be strongly limited by poor Internet connectivity limiting users in their online activities, which are more bandwidth-intensive than in the other cases under consideration. *Costs* are also considered in this case in terms of needed equipment, although such a barrier may prove less limiting than both the initial *competence* needed to use the proposed training platform and the aforementioned *connectivity* issues.
- the GR case sees its main barriers in terms of *costs*, *competence*, and *complexity*. Indeed, the proposed system is composite, foreseeing data collection from the fields and along the whole wine supply chain in the area. Although there is a clear interest for such a system and the participants recognise its potential, fears about high initial *costs* are put forward, as well as the time to familiarise with collected data, the way they are presented, and the actual information that may be extracted from them. To do so, digital skills are utterly needed (*competence*), which may require new specialised workers (thus furtherly increasing costs) and time to find a new "balance" among stakeholders in the system. The possibility of frictions among them because of the collected digital *data* and their use must be carefully evaluated.

Table 19: barriers per goal of the IT use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
IT	*1. more efficient maintenance work*[5]	limited budget [**COSTS**].	short-term vision of social actors (politicians, farmers,	divergent priorities within CTN between management	automatic data collection is hard to carry out in hostile/difficul

[5] technical barrier: lack of Internet connectivity in mountain areas. need of external data (to be identified, gathered, and integrated in an interoperable manner). 'reconciling' environmental and administrative data can prove challenging.

		funding is currently fully public because of lack of interest from private actors and lack of incentive for private actors to invest [**COSTS, REGULATIONS**]. CTN must carry out ordinary maintenance also through private actors to be paid (expenses to be fully justified) yet guaranteeing the continuity of IT services [**COMPLEXITY, REGULATIONS**].	citizens) [**COMPETENCE**]. farmers not inclined to pay for data management services [**COSTS**].	and tech level, i.e., alert management vs external data integration **[DATA, REGULATIONS]**. delays and difficulties in coordinating with other public entities to authorise interventions **[COMPLEXITY, COMPETENCE, REGULATIONS]**. CTN's choices partly dictated by the need to avoid external criticism **[DATA, REGULATIONS]**.	t-to-access natural areas [**CONNECTIVITY**].
	2. better communication between citizens and PA[6]			complex procedures because many local entities are involved in ordinary land	

[6] technical barrier: lack of Internet connectivity in mountain areas. External public entities involved in ordinary land management often have different data about considered areas and different procedures to carry out operations.

				management **[COMPLEXITY, REGULATIONS]**. mountain and lowland management actors are not sufficiently 'integrated' **[DATA, COMPLEXITY]**. political actors hard to reach [**REGULATIONS**]. weighting strategies hard to implement in terms of prioritisation strategies (are farmers' requests more urgent than citizens' ones?) **[DATA, COMPLEXITY, COMPETENCE]**.	
	3. larger involvement of citizens and farmers in monitoring watercourses[7]			weighting strategies complex to implement in terms of prioritisation	

[7] technical barrier: lack of internet connectivity in mountain areas.

				strategies (are farmers' requests more urgent than citizens' ones?) **[DATA, COMPLEXITY, COMPETENCE].**	

Table 20: barriers per goal of the GR use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
GR	*1. data collection from fields*	difficult-to-measure midterm benefits against investments [**COMPLEXITY**].	resistance to (fast/radical) change of elderly farmers [**DEMOGRAPHIC**].	no mechanisms to fully exploit digital opportunities **[REGULATIONS].**	risk of increased electrical demand [**COSTS**].
	2. data analysis and notification	more complex procedures (payments) because of digital services and multiple actors [**COMPLEXITY**].	introduction of digital tools will likely introduce friction [**FEAR, VALUES, COMPETENCE**]. need for intermediaries to handle digital tools and data [**COMPLEXITY, COMPETENCE**].	keeping a balance among affected stakeholders is challenging **[COMPETENCE, VALUES, DISTRUST]**.	
	3. tracing and authenticating products	small producers will stick to	different digital skill levels	complex platform to be adopted	complying with environmental

		simpler producers because of uncertain market drivers [**COSTS**, **SCALE**].	challenge the introduction of digital platforms [**COMPETENCE**].	generating barriers to adoption **[COMPLEXITY, COMPETENCE]**.	standards can be challenging for local actors **[COMPETENCE]**.
	4. feedback services	uncertain ROI of traceability and fees of related digital services [**COSTS**, **DISTRUST**].	engaging larger markets can prove hard to handle [**COMPETENCE, COMPLEXITY, SCALE**]. customers' feedback on digital platforms is harder to manage [**COMPETENCE, COMPLEXITY**].	needed digital skills may require new personnel (increased labour cost) **[COMPLEXITY, COMPETENCE, COSTS]**.	

Table 21: barriers per goal of the DE use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
DE	*1. offering events*	sponsoring might prevent people from using the tool [**COSTS**].	fear of negative feedback [**DISTRUST**]. poor system accessibility [**USABILITY**]. exclusion of some groups of citizens (e.g., elders)	security and other data regulations may push away people from using the tool **[REGULATIONS]**.	

			[**USABILITY, DEMOGRAPHIC**].		
	2. activating participants	costs may reduce the attractiveness of the tool and participation in events [**COSTS**].	events poorly described or too many events may lower participation [**COMPETENCE]**. discrepancy between feedback and actual participation can be demotivating [**COMPETENCE, FEAER]**.	crowded events may attract threats/risks **[COSTS, FEAR]**.	
	3. supporting events	connection with other digital tools may be hampered by changes (e.g., interfaces, …) [**COMPLEXITY, USABILITY**]. legal implications in using data from other tools [**MANAGEMENT, REGULATIONS**]. poor Internet connectivity limits the use of the tool	tracking GNSS data to be controlled [**DATA, REGULATIONS]**. not enough participation by helpers and volunteers [**DEMOGRAPHIC]**. low digital skills **[COMPETENCE].**		

		[**CONNECTIVITY**]. volume of exchanged mobile data [**COSTS**].			
	4. documenting events	difficult data export [**USABILITY**]. compliance with privacy regulations [**MANAGEMENT, REGULATIONS**].	compliance with privacy regulations **[REGULATIONS, MANAGEMENT]**. low digital skills **[COMPETENCE]**. fear of negative feedback **[COMPETENCE, FEAR].** lack of volunteers to document events **[DEMOGRAPHIC].**		

Table 22: barriers per goal of the AT use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
AT	*1. global roundwood traceability*	digital innovation perceived as threat by competitors [**COMPETENCE, FEAR**].	lack of awareness of forests' role and sustainable forest management	lack of support, funding, and innovation [**REGULATIONS, SCALE, COSTS**].	

		high costs to implement and maintain traceability [**COSTS, COMPLEXITY**].	**[COMPETENCE]**.		

Table 23: barriers per goal of the SCO use case.

Living Lab	Goal number and description	Economic	Social	Governance	Environmental
SCO	*1. engage crofters with training*	lack of broadband connectivity, digital skills, and equipment to engage with the tool [**CONNECTIVITY, COMPETENCE, COSTS].**			
	2. point crofter to potential training opportunities	lack of broadband connectivity, digital skills, and equipment to engage with the tool [**CONNECTIVITY, COMPETENCE, COSTS].**			
	3. collect feedback on training opportunities	lack of broadband connectivity, digital skills, and equipment to engage with			

		the tool [**CONNECTIVITY, COMPETENCE, COSTS**].			

Conclusions

Five use cases have been developed in DESIRA, leading to well-formed use case statements and to the definition of commonly agreed goals that the co-designed digital tools should satisfy. Then, an in-depth discussion has been carried out in workshops, focus groups, online meetings, and interviews, providing detailed decompositions of goals into tasks, the identification of actors to be involved, and the ICT equipment required.

The subsequent discussions on the potential impacts, both positive and negative, that the co-designed digital tools may have, have led participants into taking into consideration (at least some of) the plausible consequences that the introduction of such tools may cause. In this way, participants familiarised with the initial phases of software design (ideation, collection of requirements, and preliminary design), but also had a chance to reflect on how the introduction of digital technologies may affect their life and their activities, and what it is to be gained.

To achieve such a result, DESIRA has proposed a novel methodology for use cases that goes beyond the traditional one. The socio-cyber-physical system conceptualisation developed in WP1 has been used as reference framework, considering socio-economic factors and potential impacts of the technology as fundamental pieces of the process carried out in Living Labs. Indeed, fostering a Responsible Research and Innovation (RRI) based approach in open and participated Living Labs, in which goals to be reached have been collectively agreed, joint reflections on potential impacts have been carried out, and objectives and potential developments of use cases have been openly shared.

On a final note, it is worth recalling the value of the use case outputs summarised in this document for software companies looking for ideas to be fully developed. Ideas that Living Labs have already recognised as of value for their rural contexts, and of which critical points have already been highlighted, thus clearly pointing out what should be carefully considered since the very beginning for the digital tools to be (likely) positively accepted, and the actors that should continue to be involved in the next phases of the development process.

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Appendix I – Living Lab reports

IT use case

Living Lab “Toscana Nord” is in the DESIRA Italian Living Lab in the domain of rural areas.

Brief summary of LL

The Living Lab Toscana Nord has been organized around the activity of land and water management carried out by the local public authority Reclamation Consortium “Toscana Nord” (www.cbtoscananord.it). The Reclamation Consortium “Toscana Nord”, created in 2012, when such activity moved from the local level of Municipality Unions to a larger scale, is responsible for the management of an area of around 360.000 ha including both mountain and plain areas. In particular, the Reclamation Consortium “Toscana Nord” is using an app to manage the alert sent by citizens on the need for intervention with maintenance works in order to prevent floods and landslides downstream. The direct involvement of citizens in the alert activity allow to increase the efficiency of land monitoring and management. The possibility to know in real time the need to remove obstacles on upstream little watercourse, which are hard to reach by the Reclamation Consortium “Toscana Nord” staff, have a significant impact in preventing damages downstream. The Living Lab is discussing how to improve the functioning of the app and how digitalization can support the system as a whole with the aim of improving the efficiency of land management and reduce the time in answering to the citizens making the alert on the need for intervention.

LL participants

The Living Lab has been built around a network of actors, both internal and external to the public institution Reclamation Consortium “Toscana Nord” which is defining the activity of the Living Lab. In the Use Case definition phase the actors internal to the public institution, including the president, the director with responsibility of the land management of mountain areas, the IT experts, the technicians responsible for the practical management of the maintenance works, the technicians responsible for the management of alert messages from citizens more in general have been directly involved in the activities.

The management of the Living Lab is carried out with a two-level approach: a couple of key contacts are willing to exchange information more often with the DESIRA research team and to discuss them, before involving the whole group of actors in workshops and other project activities.

Timing of Use Case activities

The Use Case definition activities have been organized with two online focus groups with the technical staff of the Consorzio Toscana Nord.

- General process followed (Example: we started with interviews, then followed by focus groups, and then a plenary workshop)
- A Table with more details about the activities carried out, as in the template below:

Date / Type	Activity	Duration	Participants and Background	Output
28/04/2022 (Remote)	Focus group	1 hour	1 Leader of the Consorzio (background: agronomy) 4 technical staff (background: forest management) 1 ICT expert from Consorzio (background: ICT for land management) 2 administrative staff from Consorzio 2 LL coordinators (background 1st subject: social science, background 2nd subject: ICT for agriculture)	Initial set of goals and definition of Use case statement
05/05/2022 (Remote)	Focus Group	2 hours	1 ICT expert from Consorzio (background: ICT for land management) 2 technical staff (background: forest management) 3 LL coordinators (background 1st subject: social science, background 2nd subject: ICT for agriculture)	Goals, Actors, ICT Components, Tasks
8/06/2020	Research Team discussion	2 hours	LL coordinators (3 social sciences; 2 engineering)	Drivers, Barriers, Impacts

9/6/2020	Discussion	1 hour	LL coordinators and LL key informant	Drivers, Barriers and Impacts plus additional tasks

Use Case Summary

The objective of the system is to improve the efficiency of the hydrogeological risk management process by enhancing the monitoring system and the consequent maintenance of the territory. This can be favoured by a mechanism for integrating environmental monitoring information (consisting of climatic and hydrological data) with the human component (i.e. the monitoring of watercourses carried out by farmers and citizens' associations) and with that relating to land management (alerts from individual citizens and maintenance work carried out by the Consortium). This process may allow obtaining quality data and a control system that is also useful in reducing response times to citizens who alert. This can be further promoted by an improvement in the data transmission network between internal and external parties involved in protecting territory and citizens from the adverse effects of climate change in the form of rain, floods or landslides. There are several actors involved in this process who would benefit from the development of this technology. In addition to the Public Administration (mainly represented by the Consortium, its technicians and managers, and the administrative subdivisions [Region and Municipalities], the role of farmers and citizens is very important. The stated objectives are divided into tasks that are essentially aimed at obtaining tools that provide the Consortium with a more powerful and qualitatively better control and forecasting capacity than today. The aim is to obtain data from new sources and make correlations by integrating them with those already available (collected by sensors or available on specific platforms), to involve citizens and farmers, and to triangulate the issue of 'data-participatory management-communication and transmission' to improve outputs in terms of protecting the territory and its inhabitants. The impacts observed are indeed numerous and almost entirely positive. They cover all the required dimensions. Most of them concern the economic one and are related to the reduction of management costs through an improvement in work efficiency, which may however be accompanied by an increase in technology-related costs. Of particular relevance is the social dimension, where the involvement of citizens and farmers and the interactions between different kinds of actors (public and private) are an advantage. The greater efficiency linked to simpler and faster governance is accompanied by a reduction in hydrogeological risk, which certainly represents a success in terms of environmental impacts. It will also be possible to note how numerous and varied are the factors that promote or hinder the pursuit of these objectives.

Use case statement

Use case statement development and observations

A first general version of the use case statement was developed by the LL Coordinators based on the previous LL activities.

V1 *"The goal of the system is to improve the efficiency of land monitoring and ordinary land management in mountain areas. The use case is based on a platform which aim to integrate the alerts of citizens/farmers, with data collected by different sources (sensors, drones, satellites, farmer and citizens association), facilitating the organization of maintenance works (assignment to specific actors; planning etc.)."*

During the first focus group this version was improved thanks to the discussion with the participants and in particular the key contact of the Living Lab, who followed all the process since the beginning of DESIRA, asked to remove the specific reference to "ordinary" land management and to "mountain areas". This observation made wider the scope of the use case and of the Living Lab work more in general.

The version of the use case statement was then developed partially during the meeting and partially by the LL Coordinators after the meeting and presented again to the participants in the second focus group a week later.

V2 *The goal of the system is to integrate the information of environmental monitoring (Climate and hydrologic data) and human monitoring (farmers and citizen associations water course monitoring) with the ones on land management (individual citizens alerts and maintenance works) in order to improve the efficiency of land management and reduce the answering time to the citizens who make the alert. The system relies on a web app, on data collected from different sources and would consider the use of satellite data*

It was not easy for the participants to understand the reason for a use case statement, but once we presented them the first version, they had many comments and the discussion which took place allows the LL Coordinators to better understand the different perspectives and goals in using digitalization for the land management.

Use Case Elements

Element	List
Actors	• **Individual Citizens:** contribute to the notification of the need for maintenance works

	• **Farmers:** notify the need for maintenance works and in mountain areas is sometimes directly asked by the Consorzio to realize the specific maintenance work. • **Association of Citizens:** contribute to the notification of the need for maintenance works • **Local authorities and administrations:** contribute to the notification of the need for maintenance works, often in the name of citizens who do not have sufficient digital skills to use the app for notification. • **Administrative staff of the Consorzio:** receive the notification from citizens and upload the information on the web app • **Technical staff of the Consorzio Toscana Nord**: receive the notification from the web app and organize a physical inspection in the field, writing a report back to the director. • **President of the Consorzio Toscana Nord:** approve the answer to the citizens • **Executive:** approve the report from the technician
Goals	• **Improve efficiency of maintenance work:** this goal aim to avoid floods and landslides in mountain areas and it is needed to prevent damage downstream with appropriate land management intervention. • **Improve the communication between citizens and Public Administration**: this goal aim to reduce the time of the public administration for answering the citizens when they notify a need for intervention. • **Involve citizens' associations and farmers in the monitoring of water courses:** this goal aim to manage data resulting from the monthly reports of watercourse monitoring developed by 100 farmers and 100 citizens associations who signed an agreement with the Consorzio Toscana Nord in order to be responsible for the monitoring of specific watercourses.
Tasks	• 1. Improve efficiency of maintenance work: 1.1 ***Correlate climate events with maintenance works done in the past years*** 1.2 ***Connect climate data with each citizen notification*** 1.3 ***Involve citizens' associations and farmers in the monitoring of water courses.*** • 2. Improve the communication between citizens and Public Administration 2.1 ***Improve the communication of the Consorzio Toscana Nord with external actors*** 2.2 ***Improve the communication within the Consorzio Toscana Nord***

ICT Components	• E-mail: this component is used by citizens to send notification to the consortium • Smartphone: this component is used for sending notification, taking photos of the site, send the report to the responsible technical staff. • Messaging Apps (e.g. WhatsApp): this component is used to send notification and photos of the need for intervention in real time from the field. • Web Apps managing the notification system: This component is used to facilitate the interaction between all actor of the system • Web App URBI: this component is used to store data of the Consortium Toscana Nord. • Public climate databases (e.g. Copernicus): This component could be added to the ones currently used in order to include the use of climatic data. • Digital signature: this component is used by the executive manager and the President of the consortium to approve the responses for the citizens • Databases of the Consortium: those components could potentially be connected in order to improve their interoperability and connect data from environmental monitoring with data from land management and economic data on the use of resources. • Environmental databases: those databases are often managed by the Regional Administration (e.g. ARPA) or specific research institutes and could be better organized and made available to the technical staff of the Consortium Toscana Nord.

Elements identification process and observations

Task Descriptions

Task 1.1

Task Name: Task 1.1 - ***Correlate climate events with maintenance works done in the past years*** derives from the goal 1 – Improving the efficiency of the maintenance works.

How is this performed now?

- The climate events are not currently correlated with maintenance works done
- The main sources of climatic data are some meteorological stations located in the area and managed by the regional administration and not directly by the Consortium Toscana Nord.

- The weather stations are consulted only if needed.

- **Which are the weaknesses/issues of the current approach?**
  - The annual planning of maintenance works is based on the previous maintenance works activities without a direct connection to climate and precipitation events.
  - Alerts from citizens and public administrations are the main source of information that contribute to define areas with a higher hydrogeological risk where maintenance works are needed.
  - Different institutions are responsible for environmental monitoring data collection and data are not always integrated.

- **How can this be supported by an ICT system / digital tool?**
  - Climate data could be made available to the technical staff of the Consorzio Toscana Nord building specific interface platforms and data analytics methods.
  - Hydrologic and soil data could be organized from different sources (Consorzio, Regional Administration, Universities) in a single platform and combined with the climate data with specific data analytics methods.
  - Creating correlation between environmental monitoring data and maintenance works implemented by the Consorzio Toscana Nord in the last 5 years in order to improve the planning capacity of the public administration

- **Actors involved**:
  - Consortium Toscana Nord
  - Regional Administration
  - Universities
  - Citizens

- **ICT components:**
  - User friendly interface
  - Databases of environmental monitoring data

Task 1.2

Task Name: Task 1.2 ***Connect climate data with each citizen notification*** derives from the goal 1 – Improving the efficiency of the maintenance works.

How is this performed now?
- The climate events are not currently correlated with maintenance works done
- In case of a controversy on responsibility for damages due to absence of maintenance works specific data are collected in order to verify if the responsibility is of the Consortium Toscana Nord or is of the extreme climatic events.

- **Which are the weaknesses/issues of the current approach?**
  - Data on extreme climatic events on a specific area are not always available or easy to be collected and make the process of identify responsibilities more complex.
  - Different institutions are responsible for environmental monitoring data collection and data are not always integrated.

- Citizens are the main source of information on the state of the art before and after a specific climatic event in a specific location.

- **How can this be supported by an ICT system / digital tool?**
  - Climate data could be organized in timelines with daily rain level and a thresholds that allow to define if the individual event has been ordinary or extraordinary.
  - The time series of data could be connected to the individual event notified by the citizen in order to prove if the climatic event that created a damage was ordinary or extraordinary.
  - Combining hydrological and soil data with the climate ones could help in reducing the resolution of each intervention, improving the quality of the data in time and space.

- **Actors involved**:
  - Consortium Toscana Nord
  - Regional Administration
  - Universities
  - Citizens

- **ICT components:**
  - Databases of environmental monitoring data
  - Database of the maintenance works
  - Dashboard

Task 1.3

Task Name: 1.3 Involve citizens' associations and farmers in the monitoring of water courses

How is this performed now?

- The Consorzio Toscana Nord signed 200 agreements with farmers and citizens' associations for the monitoring of watercourses.
- Each of the 200 actors will deliver a monthly report on the status of the watercourses assigned to them.
- The technical staff should consider such reports in order to make the planning of maintenance works

- **Which are the weaknesses/issues of the current approach?**
  - The process just started as the Consorzio is still completing the assignment of watercourse to local actors for monitoring.
  - There is a problem to manage the data that will arrive every month from the local actors (200 monthly reports).

- **How can this be supported by an ICT system / digital tool?**
  - A database to collect all the monthly reports should be built.

- The database should allow to quickly identify critical situations derived from the human monitoring activities.

- **Actors involved**:
  - Consortium Toscana Nord
  - Citizens' Associations
  - Farmers

- **ICT components:**
  - Database
  - Digital forms

Task 2.1

Task Name: 2.1 ***Improve the communication of the Consorzio Toscana Nord with external actors***

derives from the goal 2 – Improve the communication between citizens and Public Administration

How is this performed now?

- The citizens can send a notification using different digital and not digital tools (WhatsApp, email, phone, letters etc.)
- The administrative staff of the Consortium Toscana Nord upload the data of the notification on the webapp.
- The technical staff organizes an inspection on the field and the citizen is notify about this or, if it is the case, will directly participate to the inspection.
- The administrative staff send an answer to the citizen that made the notification.

- **Which are the weaknesses/issues of the current approach?**
  - There is a time needed to process the messages received from the citizens.
- **How can this be supported by an ICT system / digital tool?**
  - The communication process between citizens and public administration can be automatized and the citizens, using a nice interface, could directly upload data through a smartphone app.
  - The technical staff could use a smartphone app to upload information on the system related to the inspection on the field, reducing the time of the communication process.

- **Actors involved**:
  - Consortium Toscana Nord
  - Technical Staff of Consortium Toscana Nord
  - Citizens
- **ICT components:**
  - Smartphone Apps
  - Web

Task 2.2

Task Name: 2.2 ***Improve the communication within the Consortium Toscana Nord*** derives from the goal 2 – Improve the communication between citizens and Public Administration

How is this performed now?

- The administrative staff of the Consortium Toscana Nord upload the data of the notification received by citizens on the webapp
- The President assigns the notification to the competent unit (UIO).
- A responsible technical staff receive the notification and assign it to a field technical staff.
- The field technical staff is in charge of organize an inspection on the field and to compile a report for the responsible technical staff.
- The responsible technical staff identify the right answer for the citizen (choosing among 20 different models of possible letters).
- The answer is signed by the executive with electronic signature.
- The president approves the answer prepared by the UIO
- The administrative staff send the answer to the citizens.

- **Which are the weaknesses/issues of the current approach?**
  - The internal communication process requires many steps. All innovation that can contribute to reduce the time for these steps to be performed could improve the process.

- **How can this be supported by an ICT system / digital tool?**
  - The technical staff could use a smartphone app to upload information on the system related to the inspection on the field, reducing the time of the communication process.
  - The management staff (director, president etc.) can have a look at all the internal communication process in any moment in order to double check if everything is working.

- **Actors involved**:
  - Technical Staff of Consortium Toscana Nord
  - Management Staff of Consortium Toscana Nord
- **ICT components:**
  - Smartphone apps
  - Dashboard

Impacts, Drivers and Barriers

Impacts

Tasks	Goal	Impact

Task 1.1 Correlate climate events with maintenance works done in the past years. Task 1.2 Connect climate data with each citizen notification.	**Goal 1** Improve efficiency of maintenance works.	**Economical:** ● Reduction of legal expenses, thanks to better evidence of relationships between extreme climatic events and damages. [POSITIVE] ● Reduction of extraordinary land management, thanks to a more efficient ordinary land management. [POSITIVE] ● Optimization in the use of resources thanks to a quicker management process (increase of cost/benefit relationship). [POSITIVE] ● Increase of funding opportunities due to the effectiveness of the system developed. [POSITIVE] ● Increasing expenses in technology management. [NEGATIVE] **Social:** ● Increased interaction between public and private research activities. [POSITIVE] **Governance:** ● Improved coordination among different institutions responsible to collect different types of environmental monitoring data. [POSITIVE] **Environmental:** ● Improved control of territory. [POSITIVE] ● Reduction of hydrogeological risk. [POSITIVE] **Technical:** ● Improved integration among different data sources. [POSITIVE]
Task 1.3 Involve citizens' association and farmers in the monitoring of water courses.	**Goal 1** Improve efficiency of maintenance works.	**Economical:** ● Reduction of extraordinary land management, thanks to a more efficient ordinary land management. [POSITIVE] ● Optimization in the use of resources thanks to a quicker management process (increase of cost/benefit relationship). [POSITIVE] ● Optimization on resource allocation for maintenance works to actors external to the Consortium (farmers, forest managers etc.). [POSITIVE]

		Social: ● Involvement of all citizens, including farmers, in land monitoring. [POSITIVE] ● Increased sense of participation to the land management process by the local community. [POSITIVE] ● Reduced need of inspection on the field by technical staff. [NEGATIVE] **Governance:** ● Relationships and responsibilities clearer among political and social actors. [POSITIVE] **Environmental:** ● Improved control of territory. [POSITIVE] ● Reduction of hydrogeological risk. [POSITIVE]
Task 2.1 Improve the communication of the Consorzio Toscana Nord with external actors. Task 2.2 Improve the communication within the Consorzio Toscana Nord.	**Goal 2** Improve the communication between citizens and Public Administration.	**Economic:** ● Improved organization of work and efficiency of the workflow. [POSITIVE] **Social:** ● Involvement of all citizens, including farmers, in land monitoring. [POSITIVE] ● Increased sense of participation to the land management process by the local community. [POSITIVE] **Governance:** ● Management process more simplified and quicker. [POSITIVE] **Environmental:** ● Reduction of hydrogeological risk. [POSITIVE]

Drivers

Tasks	Goal	Driver
Task 1.1 Correlate climate events with maintenance	**Goal 1** Improve efficiency of	**Economical:** ● Need to defend the activity of the consortium in case of legal actions, using comparison between climatic data and maintenance works.

works done in the past years. <u>Task 1.2</u> Connect climate data with each citizen notification.	maintenance works.	● Availability of resources for digitalization and exploitation of earth observation datasets (e.g. PNRR) ● Possibility to reduce the cost of maintenance works due to the increase efficiency of the system. **<u>Social:</u>** ● Need to be more precise in giving feedback on damages to citizens **<u>Governance:</u>** ● Political interest in getting more precise information from different sources. ● Need to identify responsibilities of hydrogeological damages. ● The possibility to integrate the citizens alerts with more objective data (environmental monitoring data) facilitate the prioritization of alerts made by different actors. ● Interest in increasing digitalization of mountain areas. **<u>Environmental:</u>** ● Incremental damages due to extreme climatic events.
<u>Task 1.3</u> Involve citizens' association and farmers in the monitoring of water courses.	**<u>Goal 1</u>** Improve efficiency of maintenance works.	**<u>Economical:</u>** ● Availability of resources for digitalization and exploitation of earth observation datasets (e.g. PNRR) ● Possibility to reduce the cost of maintenance works due to the increase efficiency of the system. **<u>Social:</u>** ● Willingness of farmers and citizens to be part of a community and contribute to land management. **<u>Governance:</u>** ● Political interest in getting more precise information from different sources.

		● The possibility to integrate the citizens alerts with more objective data (environmental monitoring data) facilitate the prioritization of alerts made by different actors. **Environmental:** ● Incremental damages due to extreme climatic events ask for a more efficient ordinary land management.
Task 2.1 Improve the communication of the Consorzio Toscana Nord with external actors. Task 2.2 Improve the communication within the Consorzio Toscana Nord.	**Goal 2** Improve the communication between citizens and Public Administration.	**Economical:** ● Improve the efficiency of workflow within the Consortium ● Availability of resources for digitalization and exploitation of earth observation datasets (e.g. PNRR) ● Possibility to reduce the cost of maintenance works due to the increase efficiency of the system. **Social:** ● Need to be more precise in giving feedback on damages to citizens ● Need to reduce the time in giving answers to citizens **Governance:** ● Political interest in giving precise and quick feedback to citizens. ● The possibility to integrate the citizens alerts with more objective data (environmental monitoring data) facilitate the prioritization of alerts made by different actors. ● Interest in increasing digitalization of mountain areas. **Environmental:** ● Incremental damages due to extreme climatic events.

Barriers

Tasks	Goal	Impact
Task 1.1 Correlate climate events with maintenance works done in the past years. Task 1.2 Connect climate data with each citizen notification.	**Goal 1** Improve efficiency of maintenance works.	**Economical:** ● Need to allocate a budget to a defined subset of activities (cannot do everything because the budget is limited). ● Funding is exclusively sourced from public actors, because start-ups or other private actors might not have an interest in investing in this innovation. ● Public entities finance public entities more easily, so private entities have no incentive to invest. ● There is a need to justify the funding of specific private entities, and at the same time ensure the continuity of the IT service. **Social:** ● Difficulty related to the short-term vision of social actors (politicians, farmers and citizens). ● Farmers are not inclined to spend for data management services. **Governance:** ● There are differences in vision between management and technicians: management is oriented towards alerts management, whereas technicians are more oriented towards external data integration. ● It is necessary to communicate with other institutions, especially with the Genio Civile who has to authorise interventions. ● Need for the consortium not to expose itself to criticism with respect to its maintenance work. **Environmental:** ● Difficulties in installing sensors in areas difficult to access or in 'hostile' environments. **Technical:** ● Lack of communication in mountain environments. ● Need for identification and acquisition of data that are external to the consortium (e.g. Data shared

		with the consortium and collected by public institutions or consortium partners). ● Interoperability: complexity of integrating heterogeneous data. ● Interoperability: difficulties in integrating environmental data with administrative data.
Task 1.3 Involve citizens' association and farmers in the monitoring of water courses.	**Goal 1** Improve efficiency of maintenance works.	**Economical:** *See economical barriers above* **Social:** *See social barriers above* **Governance:** ● Difficulty in giving different weight to different actors, because it prioritises the opinion of a subset of them (farmer >> citizen comment). **Technical:** ● Lack of communication in mountain environments. ● Alerts may come from different types of actors (citizens, municipalities and farmers).
Task 2.1 Improve the communication of the Consorzio Toscana Nord with external actors. Task 2.2 Improve the communication within the Consorzio Toscana Nord.	**Goal 2** Improve the communication between citizens and Public Administration.	**Economical:** *See economical barriers above* **Social:** *See social barriers above* **Governance:** ● There is a need for integration with municipal union and different participants. ● It is necessary to do integration with mountain management actors and lowland management actors. ● Difficulty in communicating with political actors and gathering the views of municipalities ● Difficulty in giving different weight to different actors, because it prioritises the opinion of a subset of them (farmer >> citizen comment). **Technical:**

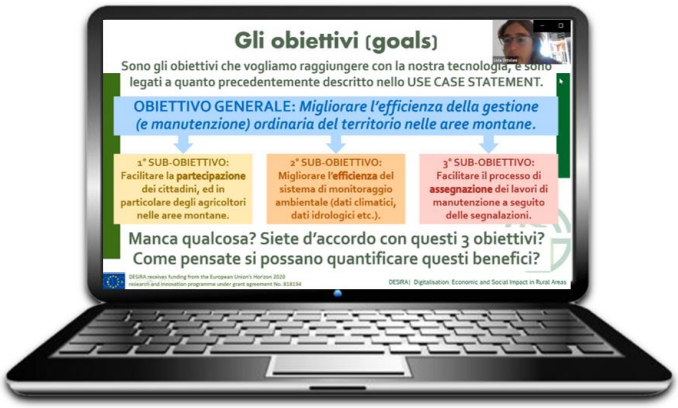
		● Lack of communication in mountain environments. ● Difference between databases and procedures of other institutions (e.g. Genio Civile). ● Alerts may come from different types of actors (citizens, municipalities and farmers).

Identification process and observations

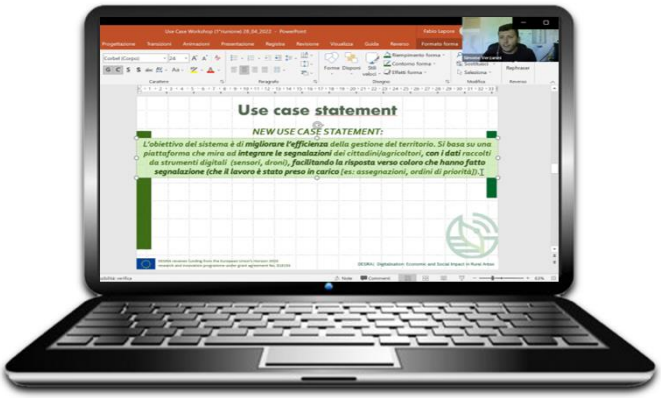
Photos and Additional Material

PPT presentation prepared for the Workshop on the use case; useful as a guide and as a board to write notes and make them visible to ***participants*** to make data collection interactive.

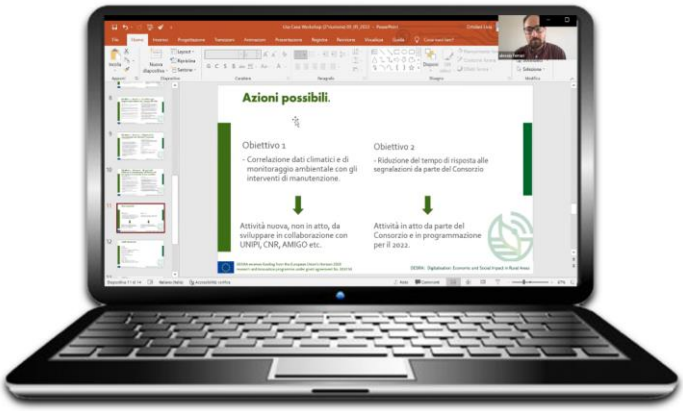
Professor ***Gianluca Brunori*** introduces the DESIRA H2020 project to the participants of the first use case meeting.



Livia Ortolani, the coordinator of Living Lab Toscana Nord, explains the Use Case methodology to the participants.



The participants discuss and ***Fabio Lepore*** takes notes in real-time on a PPT prepared for this purpose (in this case, a new Use Case Statement is being defined together with the participants to replace the one proposed)



Alessio Ferrari facilitates the discussion by proposing ideas and stimulating debate.

GR use case

Digital services for farmers and rural communities.

Brief summary of LL

This Living Lab runs in collaboration with the American Farm School of Greece and focuses on co-development of digital solutions with farmers that are located in rural areas of Northern Greece.

It initially started its operation in the area of Trilofos, a village and community belonging to the municipality of Katerini. This region has a long tradition with tobacco cultivation, but in the recent years the position of the local farmers in the supply chain has been weakened, mainly due to the production limitation system EU has applied to tobacco and the suspension of any subsidies to tobacco growers. At the same time the economic risk and dependency from the local tobacco distributors-retailers is being increased.

In its first stage, this Living Lab delved into the identification of digital services and functionalities aiming to propose suitable digital solutions and ways to implement them to a group of experienced farmers that are gradually transitioning from tobacco to leek cultivation. The lack of a short-midterm revenue prospect, lack of support by the local authorities coupled with the difficulties that the tobacco cultivators faced in adjusting their agricultural routines to the functionalities and services the ICT solutions provided, have led the farmers to abandon their agricultural activities, a fact that steered the focus of this Living Lab into its second stage.

In this later stage the focus of the Living Lab remained the same, what changed is the geographical location, moving further to the Nord, to Goumenissa, an area well-known for the cultivation of grapes. In the current phase the LL focuses on a wide group of grape cultivators and winemakers-owners that aim, in a collaborative manner, to experiment with new digital solutions that will enhance their wine supply chain and utilise digital functionalities that can provide quality guarantees for the creation and establishment of a distinct local wine product.

LL participants

The use case workshop was co-organised and co-hosted by ATHENA Research Centre (ARC) and the American Farming School (AFS), that holds a dual role of both innovation facilitator in the LL's SCP system, and ARC's contact point for the purposes of this LL.

The meeting was attended by forty participants varying from local and well-known grape and wine producers that operate in the region, smaller local farmers and wine producers that coalesce into an informal local union, as well as representatives from the regional directorate of rural economy and veterinary, representatives from the regional and local governance. A highlight of the meeting has been certainly the participation of the Greek Minister of Rural Development and Food, who expressed his support in this endeavour.

Timing of Use Case activities

The use case activities started with a series of interviews that were essential for defining the basic elements, requirements, and scope of the use case as well as, fixing the organisational aspects of the workshop.

The first two interview sessions were conducted with the participation of the American Farming School that acts as this LL's contact point organisation and other actors operating in the region (agronomists and extension service providers). The interviews were conducted in a semi-structured manner addressing relevant questions to each participant trying to understand what are the different roles that interact within Goumenissa winemaking production and supply chain and what types of resources, infrastructure and provisions are available.

A third interview session followed with the participation of ICT providers that expressed interest to operate in the region. This interview was fundamental for defining the potential technology options that could be the focus of the use cases user-system interaction.

Finally, during the use case workshop a wide range of local actors participated at its activities. During the workshop the following steps took place for the design of this use case:

a) Identification of shared goals, soft goals, and vision among the participants.

b) Display of the available digital technology options and discussions on potential benefits, impacts, barriers, associated with the adoption of the existing technology options.

c) Discussion of other potential technological solutions that could be adopted in the specific case.

d) Discussion and co-design of the use case activities and tasks performed by the respective actors and spotting of solutions to potential shortcomings for the actuation of tasks.

Date / Type	Activity	Duration	Participants and Background	Output
18/03/2022 (Remote)	Interview	1 hour	2 x AFS experts (Project management, consultancy service providers)	Redefine the focus group of the LL and identify the scope of the use-case and relevant actors that should be included.
13/04/2022 (Remote)	Interview	1 hour	1x Local Agronomists	Define the baseline, aims and benefits of

			2x Representatives of InoFA cluster (Internet of Food Alliance) (Agronomists, life sciences)	the use case workshop and adjust the workshop activities based on the future participants group
29/04/2022 (Remote)	Interview	1.5 hours	1 Head of ICT's development company (extension & agricultural service providers) 2 LL coordinators	Identify the range of available ICT tools and their potential functionalities in the use case context.
13/05/2022 (Physical)	Focus Group	3 hours	2 ICT experts 4 Local authority agronomists 3 National and regional authority representatives 3 Regional technology providers and Innovation facilitators 20 Local grape farmers and winemakers	Drivers/Barriers, Goals, Actors, ICTs, Tasks other components and considerations for the use case's functionality.

Use Case Summary

The following use case is based on the development of the LL 'Digital services for rural and farmers communities' and is designed to specify functionalities and delineate tasks and actions that show how LL stakeholders and other relevant actors adopt and exploit digital tools to achieve their goals. The overarching scope of the use case is to enable information flows and facilitate data collection mechanisms throughout the entirety of winemaking production and distribution process.

The functionalities, that will be reported in more detail to the later sections of this document, take two directions.

The first one originates as a continuation of the past LL activities, targeting to the expansion of a LoRa WAN network in the agricultural fields of Goumenissa region, and the deployment of a Cloud platform capable of connecting devices (sensors) to the cloud services and enable real time data processing and

control. The local grape growers and winemakers will be able to access the platform and register field data on demand as well as, receive valuable information through visualized data displayed in the platform.

The second direction builds on the first one and expands the functionality boundaries with the deployment of a traceability system that allows its operators to register information visible to the public on specific quality, environmental, and production attributes of the wines produced. Furthermore, the system utilises the blockchain technology to create a constant flow of immutable data on supply chain operations as well as to provide a mean to directly connect producers and consumers improving the transparency in the whole value chain and increasing the product value of the winemaking industry of the region.

Use case statement

The goal of this use case is the development of a system responsible for the collection, gathering and analysis of data across the wine supply chain, starting from grape producers and moving towards vineyards, wineries and finally wine consumers. The system aims to enhance the traceability and security aspects of the products (wines), as well as increase resilience in the wine value chains while strengthening the position of farmers and wine producers in the market.

Use case statement development and observations

The unique attributes of the grape varieties and distinct flavor of local wines produced in the vineyards of Goumenissa (Northern Greece), pose a strong incentive for the local actors to examine solutions that will upgrade the existing supply chain, increase the monitoring of the wine production to standardize the quality of local wines, and moreover experiment with newly introduced methods that can provide additional value to their final product and strengthen their position to the value chain. The identification process of the use case statement was conducted throughout all the use case activities described in section 1.4, by gradually extracting information on how the local wine industry operates and how the numerous stakeholders/actors and flows (products, services, information) formulate interactions and interdependencies. The use case statement was formulated from a supply chain perspective, trying to pinpoint the needs and obstacles that appear in the local wine production system as well as the goals and aspirations of local stakeholders. The use case statement factors the involved entities that operate in the region and the potential synergies that can be formulated to contribute both in tangible and intangible components and resources aiming to establish more resilient local value chains and create distinctly marketable local brand wine production.

Use Case Elements

Element	List
Actors	**Grape Growers & Wine Makers:** In this use case Grape growers and Wine makers for the most part account for the same set of actors that hold a dual role but also describe distinct individuals that are solely occupied in the primary (grape growers only) or secondary sector (winemakers only). These actors are the main technology beneficiaries whose products will be the core (focus subject) for applying a traceability system across the wine supply chain. **Wholesalers and Retailers:** Wholesalers and Retailers are the intermediary supply providers of the wine products in the market. They pose the important link between production and consumption and though are not actively included in the development process of the use case; they still hold a critical role that needs to be considered for the use case purposes. **Wine Consumers:** Similar with the wholesalers and retailers, consumers describe a broader category of individuals that are not directly involved in the use case development holding a passive role. However, a key factor for measuring the efficiency of the use case application is through tracking consumer actions. **Technology Providers:** The description of technology providers applies for two types of providers, the first one is the infrastructure providers and owners (LoRA WAN network, sensors and IoT devices) that are already (or will be in the future) installed in the region, and the second one describes the traceability system developers and administrators that provide IoT and tracking modules as well as farm and consumers apps that enable the systemization of traceability and control features in this use case. **Agronomists/Agricultural consultants:** Agronomists play a crucial role for the functional operation of this use case. Grape growers and wine producers belong in a specific demographic profile that is characterised from the lack of digital competencies having also very limited previous experience with digital agricultural tools. Agronomists play a facilitating role that bridges the prevalent digital skill gap and ensures the actuation of digital tools in wine production as well as the active involvement of farmers with the new digital methods.
Goals	**1) Monitoring and data capturing of the growing fields** This goal aims to setup routines that will enable the collection and exchange of data and information and will further facilitate the adoption of digital tools on grape cultivation and wine production.

	2) Data analysis and notification system in the wine supply chain This goal aims to establish procedures that allow the monitoring and ensure cultivation, standardization, and processing procedures **3) Tracing and product authentication:** This goal aims in corelating production quality by growing region and attribution of production characteristics and traits in the final product. **4) Product feedback** This goal aims to extend the grape growers and wine producers' agency over their product further down the supply chain and create a feedback channel with the consumers of their products.
Tasks	**Goal 1) Monitoring & data capturing from the fields** ○ **Task 1.1 Registration of growing fields:** Registering the geographic location and climatic profile of the existing fields and creation of distinct wine zones to be associated with the final wine products. ○ **Task 1.2 LoRa Network setup and Deployment of sensors and IoT devices:** Thorough inspection and evaluation of the LoRa network coverage in the region and installation of gateways and sensors in indicated locations to cover the data exchange areas. ○ **Task 1.3 Daily accumulation of data from sensors to the cloud data storage:** Periodic automatic capturing of field data transmitted to the LoRa gateway and uploaded to cloud platform. ○ **Task 1.4 On demand data capturing from grape growers:** Establish processes and features that enable the on-demand upload of relevant field and crop information from the farmers to the cloud platform. **Goal 2) Data analysis and notification system in the wine supply chain** ○ **Task 2.1 Terroir identification:** Identification, recording and tracking factors such as the soil, topography, and climate of the fields in the region. ○ **Task 2.2 Cultivation monitoring and notification provision:** Regular on-site checks and provision of notification and warnings to the farmers and agronomists regarding weather

forecasting, soil moisture and temperature, pests warning and prevention, and watering management.

- **Task 2.3 Information flows to winemakers:** Extend-bridge the information and data flows from the primary sector (grape growing) to the secondary sector (winemaking).

Goal 3) Tracing and product authentication:

- **Task 3.1 Establish data flow and information gathering:** Create and assign isotopic-nutritional profiles, quality certifications and product templates.
- **Task 3.2 Identify product & match with product profiles/information using ISO standards.**
- **Task 3.3 Application of traceability features on the supply chain:**
  - Product identification placement on the output product of wineries to enable traceability features.

  Deployment of
  - Farm applications utilized from farmers and agronomists to enable the monitoring of grape distribution and enable the correlation of grape yields with the wine production.
  - Establishment of tracking modules from wineries to retailers to monitor the wine supply.

Goal 4) Product feedback

- **Task 4.1 Detailed display of product info:** Display a range of product information (isotopic, nutritional, iso certifications & quality standards etc) through a mobile app to the consumers.
- **Task 4.2 Collect feedback from users:** Provide the consumers the option, through the mobile app feature, to leave feedback on the product they bought/consumed.
- **Task 4.3 Notify involved actors on Consumers opinion:** Provide the grape growers and winemakers with the option to have access, get notifications, review and respond to the consumers' feedback.

ICT Components	• **LoRa WAN Gateway:** The LoRa WAN gateway is used as a router to receive information from the on field sensors. • **On Field Agricultural Sensors:** Sensors serve for the regular and automatic agricultural measurements and enable the processing of data to useful information for the grow and needs of grape cultivation as well as the warning of infections from pests and diseases. • **Profiling & tracing modules:** IoT, Isotopic and nutrition profile, tracing modules provide information and continuous monitoring capabilities on geospatial data, satellite imagery, nutritional data of the grapes and wines as well as date-time-location information of the stock in supply. • **Portal for data handling and display:** Serves in gathering and input information about weather conditions, physicochemical properties and geospatial imagery of the fields and soil. User's data are stored in a cloud-based database so users can access their data anytime. Each farmer can input information and soil analysis data for more than a single field. • **Consumer Application:** Extend the features and services of wine producers beyond the retailer's 'shelf' by providing consumer information, rating and feedback capabilities.

Elements identification process and observations

The identification of use case elements was based on enquiries and open discussions that were conducted throughout all the steps of the use case activities. The initial preparatory-steering meetings and the use case workshop contributed each to their own effect in defining the use case's set of actors, how their activities may affect the use case as well as their aims and goals. Understanding how the current relations and interactions are shaped and identifying what are the past events that caused this shaping, was important for the design of the use case. While local grape growers and winemakers consist the core elements/actors of this use case, *the relation* with the local agronomists, representing the regional directorate of rural economy, and their recent *collaboration* with the American Farming School, operating as the technology provider- innovation facilitator in the region, are key factors that define a) what is the array of available ICTs and infrastructure to be deployed, b) how future tasks can be designed to serve the goals of the local grape-growers and winemakers, c) what type and in which extent additional support is needed to perform the designed tasks for the purposes of this use case development.

Task Descriptions

Task 1.1 Registration of growing fields: (Goal 1: Monitoring and data capturing of the fields)

- **How is this performed right now?**
    - Growing fields are not categorised into distinct wine zones, registration is only taking place in form of property rights.
- **Which are the weaknesses/issues of the current approach?**
    - The lack of registration of the growing fields hamstrings the organised wine production in a regional scale.
    - Missing opportunity to acquire valuable information to associate the local geographical idiosyncrasies with the local wine product.
- **How can this be supported by an ICT system / digital tool?**
    - Agronomists along with the regional directorate of rural economy (in collaboration with the owners of the growing fields) to proceed with the creation of a cloud data base to register the fields and record their isotopic profile.
- **Actors Involved?**
    - Agronomists
    - Field Owners
    - Regional directorate of rural economy
    - Technology providers
- **ICT components?**
    - Cloud infrastructure
    - Data platform

Task 1.2 LoRa Network setup and deployment of sensors and IoT devices: (Goal 1: Monitoring and data capturing of the fields)

- **How is this performed right now?**
    - There is a LoRa WAN gateway, and 12 on-filed sensors already installed, covering a small indicated geographic area of the region.
- **Which are the weaknesses/issues of the current approach?**
    - The current scale of remote coverage is very small compared to the capacity of the region. The LoRa transmission has the capacity to cover more than 200 sensors that could be placed in strategic locations of interest.
- **How can this be supported by an ICT system / digital tool?**

- The LoRa network providers in collaboration with the local agronomists install sensors in indicated geographic position to gradually increase the coverage that will allow the timely and remote monitoring of the cultivation process

- **Actors Involved?**
  - LoRa network providers
  - Agronomists
  - Grape Growers and field owners (consent)
- **ICT components?**
  - IoT devices
  - On-field sensors

Task 1.3 Daily accumulation of data from sensors to the cloud data storage: (Goal 1: Monitoring and data capturing of the fields)

- **How is this performed right now?**
  - This task is partially performed in the limited area covered by the existing LoRa network and sensors
- **Which are the weaknesses/issues of the current approach?**
  - Underutilisation of the existing capital and infrastructure that hamstrings the upscale of agricultural wine production business in the region.
- **How can this be supported by an ICT system / digital tool?**
  - After the installation of digital infrastructure this automatic process will enable the regular data capturing of on field data that will in turn allow their further processing.
- **Actors Involved?**
  - Network and Digital infrastructure providers
- **ICT components?**
  - LoRa WAN network
  - On field sensors
  - Cloud storage space

Task 1.4 On demand data capturing from grape growers: (Goal 1: Monitoring and data capturing of the fields)

Establish processes and features that enable the on-demand upload of relevant field and crop information from the farmers to the cloud storage.

- **How is this performed right now?**
  - This task is not performed in the current context.

- **Which are the weaknesses/issues of the current approach?**
    - Missing feature that could enrich the data exchange and incentivise the involvement of farmers and agronomists with new digital tools
- **How can this be supported by an ICT system / digital tool?**
    - Grape growers or collaborating agronomists will manually use a mobile app that will allow the capturing and recording of measurements, data and photos to be stored in the cloud and displayed in the platform
- **Actors Involved?**
    - Grape growers
    - Agronomists
- **ICT components?**
    - Mobile Apps
    - Cloud storage
    - Cloud platform

Task 2.1 Terroir identification (Goal 2: Data analysis and notification system in the wine supply chain)

- **How is this performed right now?**
    - For the most part terroir identification is not conducted in an organized way. Growers cultivate in the fields that are under their possession or have access to.
    - Individual grape growers proceed to terroir identification on their own initiative
- **Which are the weaknesses/issues of the current approach?**
    - Grape yields are placed in growing fields that are not spatially or geologically suitable
    - Wine production is not consistent in terms of quality since annual yields differ due to discrepancies in weather condition or cultivation processes.
- **How can this be supported by an ICT system / digital tool?**
    - Agricultural consultants gather spatial, geological data and satellite imagery of the region to accumulate information on befitting growing fields.
- **Actors Involved?**
    - Agricultural consultants
- **ICT components?**
    - Satellite coverage
    - On Field sensors

Task 2.2 Cultivation monitoring and notification provision (Goal 2: Data analysis and notification system in the wine supply chain)

- **How is this performed right now?**
    - Most of the grape growers cultivate the fields based on their experience and tacit knowledge
    - Few of the growers benefit from remote monitoring and control of their cultivation (fields that have the 12 installed sensors)
- **Which are the weaknesses/issues of the current approach?**
    - Cultivation routines vary, impacting the overall consistency of the wine production.
- **How can this be supported by an ICT system / digital tool?**
    - Technology providers/facilitators gather through the LoRa network, installed sensors and satellites, timely data on weather and soil conditions to monitor the cultivation process of the growing fields.
    - Agronomists access the data portal and process the data gathered to assess the progress and status of the cultivation
    - Grape Growers in collaboration with the agronomists proceed into indicated actions to avoid cultivation risks and hazards and ensure the yield.
- **Actors Involved:**
    - LoRa network providers
    - Agronomists
    - Grape Growers
- **ICT Components**:
    - IoT devices
    - On-fields sensors
    - Data platform

Task 2.3 Information flows to winemakers (Goal 2: Data analysis and notification system in the wine supply chain)

- **How is this performed right now?**
    - This task is partially performed in a non-structured manner mainly due to the double wielding role of many of the actors in the region (both grape growers and winemakers)
- **Which are the weaknesses/issues of the current approach?**
    - Wine makers that are not also growers do not have access to grape growing information
    - Information is mostly processed empirically from grape cultivation to winemaking.
- **How can this be supported by an ICT system / digital tool?**

- Wine makers will be able to access through their farm app processed and modified data and information extracted from the on-field sensors, stored in the cloud relevant with the status of grape yields that will be inputted in their wine production process.

- **Actors Involved?**
  - Winemakers
  - Network Providers
- **ICT components?**
  - Farm Application
  - Data platform
  - Cloud storage

Task 3.1 Establish data flow and information gathering (Goal 3: Tracing and product authentication)

- **How is this performed right now?**
  - No information flow or data gathering is taking place regarding tracing and product authentication.
- **Which are the weaknesses/issues of the current approach?**
  - The local wines produced are not being accompanied by information such as variety, size, quality certificates, harvest and post-harvest practices, photographs.
  - Lacking quality controls of food safety over maximum residue limit and pesticide usage
  - Missing logistics planning and real-time tracking of wine lots in the supply chain.
- **How can this be supported by an ICT system / digital tool?**
  - Develop data capturing module by using blockchain technology to ensure data transparency and security
    - register relevant information for product profiling on the platform
    - document the special attributes that declares the local wine identity.
    - Follow labelling and packaging transformation processes applying product identification and marking tool
    - Display the complete data collected from the capturing and tracking modules to the Consumer mobile application in a user-friendly manner.

These track and trace methods will help the grape growers and winemakers document compliance with legal requirements, customer and trading partner standards and document the special attributes that declares the local wine identity to both the legal authorities and the final consumers.

- **Actors Involved?**
  - Grape growers & Winemakers

- Blockchain providers

- **ICT components?**
  - Data registries
  - Farm Application
  - Consumer Application
  - Blockchain platform
  - IoT modules
  - QR/Barcodes/imprinting tools and techniques

Task 3.2 Identify product & match with product profiles/information using ISO standards (Goal 3: Tracing and product authentication)

- **How is this performed right now?**
  - This task is not performed in the current context.
- **Which are the weaknesses/issues of the current approach?**
  - Producers are unable to properly advertise their products in bigger markets outside their local or regional network.
- **How can this be supported by an ICT system / digital tool?**
  - Grape growers and winemakers will document and register information, the IoT modules of the blockchain entail a quality module that provide information on compliance quality standards.
- **Actors Involved?**
  - Producers
  - Blockchain providers
- **ICT components?**
  - Blockchain platform
  - IoT modules

Task 3.3 Application of traceability features on the supply chain (Goal 3: Tracing and product authentication)

- **How is this performed right now?**
  - Most grape growers and winemakers do not apply any sort of tracking application (only one winery applies QR coding on its products).
  - The already established supply chains do not support further information flows for the input of grapes and wines.

- **Which are the weaknesses/issues of the current approach?**
    - Producers and winemakers have less information and agency over their products in the supply chain.
- **How can this be supported by an ICT system / digital tool?**
    - Actors that operate in the same supply chains to liaise with private providers that enable traceable supply chains through the deployment of IoT modules (devices) that store data using blockchain technologies to cloud platform.
- **Actors Involved?**
    - Grape growers & Winemakers
    - Wholesalers & retailers
    - Blockchain providers
    - Consumers
- **ICT components?**
    - IoT modules (internal and external tracing modules)
    - Blockchain platform
    - Farm App
    - Consumer App

Task 4.1 Detailed display of product info (Goal 4: Product feedback)

- **How is this performed right now?**
    - The local established wineries have built some reputation in the local markets and through the wholesalers and retailers try pass down partial information to the consumers.
- **Which are the weaknesses/issues of the current approach?**
    - Lack of legitimacy, transparency, control, and limited extent of information the consumers receive.
- **How can this be supported by an ICT system / digital tool?**
    - The consumers will register in the product profiling templates of the traceability platform all the relevant information that they would like to be displayed by scanning their products.
    - Platform will automatically check and notify the producers and platform providers about the iso and quality standards regarding the products.
- **Actors Involved?**
    - Grape Growers

- Winemakers
- Traceability platform providers
- Consumers

- **ICT components?**
  - Traceability platform
  - Profile templates in the Farm application
  - Mobile Consumer App

Task 4.2 Collect feedback from consumers (users of the consumer app): (Goal 4: Product feedback)

- **How is this performed right now?**
  - Collection of feedback is not taking place through an established mechanism.
- **Which are the weaknesses/issues of the current approach?**
  - Producers do not benefit from an established feedback loop with the consumers, lack of opportunity to make changes on the product or maintain quality standards that reflect positively In the market.
- **How can this be supported by an ICT system / digital tool?**
  - The consumers will access in a free of charge mobile app that will be part-extension of the traceability platform deployed and will be able to get informed on the available products.
- **Actors Involved?**
  - Consumers
  - Traceability platform providers
- **ICT components?**
  - Traceability platform
  - Consumer App

Task4.3 Notify producers on Consumers' opinion: (Goal 4: Product feedback)

- **How is this performed right now?**
  - This task is performed in the limited extend of the 'word of mouth' through personal relations that are built in the local scale and across local short supply chains.
- **Which are the weaknesses/issues of the current approach?**
  - The feedback received is very limited and the factor of personal relationships affects the information bias.
- **How can this be supported by an ICT system / digital tool?**

- The producers will be able to receive valuable consumers feedback displayed on the traceability platform about their products to improve their production processes.

- **Actors Involved?**
  - Grape Growers
  - Winemakers
  - Platform providers
- **ICT components?**
  - Farm App
  - Traceability platform

Task description process and observations

To proceed with the task description definition and documentation we tried to create a shared understanding of how the actors perform certain procedures related with wine production and distribution, the core activities they undertake and where we might make improvements with additional tasks that will be directly linked with the goals of the use case. Prior defining specific tasks we aimed in identifying if common interests and aspirations exist in the participating group of actors of our workshop. The majority of actors (weather representing the producers, winemakers, technology providers or agronomists' occupation) shared mutual interests under the common goal of upgrading the local wine production and make steps towards creating a distinct local brand of wines, therefore we were able to proceed, having a common baseline, with the mapping, the design and the documentation of tasks.

The first step was to ensure that the participants of the workshop have a common understanding on targeted improvements that will enhance their business routines and provide additional value to their product. Subsequently, we aimed in providing a baseline for improving tasks that will help understand which processes and activities on the grape cultivation and wine distribution would be impacted if a change was to be made. Furthermore, the designed tasks were put into a context of fitting the core existing agricultural and production processes and have the potential to be linked with measurable inputs and outputs.

Concluding, the type of action, physical or digital location, timing, technological and administrative aspects were discussed before concluding on each task described. It is worth noting that digital skills and existing knowledge on digital tools was a significant factor/dimension during the task identification, the designed tasks of the use case are directly linked with the deployment of ICT tools which are also performed in the digital space and since the main beneficiaries of this use case (grape growers and wine makers) possess limited digital skills, an additional challenge arose on how certain tasks processes could be assigned in other adept personnel/actors able to perform.

Impacts, Drivers and Barriers

Impacts

Tasks	Goal	Impact
Task 1.1 Registration of growing fields Task 1.2 LoRa Network setup and deployment of sensors and IoT devices Task 1.3 Daily accumulation of data from sensors to the cloud data storage Task 1.4 On demand data capturing from grape growers	**Goal 1** Monitoring and data capturing of the fields	**Economic:** ● Requirement of starting investment or payment agreement, fees of grape-growers and network providers for the establishment of infrastructure and maintenance costs of cloud services and IoT devices. **Social:** ● Allow the introduction of new methods that will supplement the traditional cultivation routines and will provide new incentives for the local growers and winemakers develop new skills and acquire knowledge. **Governance:** ● Receive information in shot term that can be used for the future regional planning of policies and measures **Environmental:** ● Analytical mapping of the region that will allow better terrestrial usage and rural architecture design to better utilise the natural resources of the region, avoid unnecessary sources nature stress and safeguard the flora and fauna.
Task 2.1 Terroir identification Task 2.2 Cultivation monitoring and notification provision	**Goal 2** Data analysis and notification system in the wine supply chain	**Economic/Social** ● The tasks of this goal share similar social and economic impacts with the tasks described in Goal 1 since the main economic factors associate with the initial investments needed for the payment scheme needed for the maintenance cost and service provision of the technology providers. Similarly, in the aspect of social, impacts, new digital tools will stimulate the local actors to

Task 2.3 Information flows to winemakers		contemplate and re-evaluate their business and agricultural methods. **Governance:** ● Steer synergies between the primary and secondary business sectors operating in the region. **Environmental:** ● Reduction of the agricultural waste, residues and agrochemicals, optimise the amounts of agricultural inputs, sustainable usage of watering.
Task 3.1 Establish data flow and information gathering Task 3.2 Identify product & match with product profiles/information using ISO standards Task 3.3 Application of traceability features on the supply chain	**Goal 3** Tracing and product authentication	**Economic:** ● Increase the inherent value of the wines produced ● Create competitive advantages of local wines to enter national markets **Social:** ● Provide transparency and legitimacy on the local business practices of wine production **Governance:** ● Allow a detailed analysis of market transactions, flows and local market dynamic **Environmental:** ● Optimize logistic services across the supply chain, reducing the ordering and transportation carbon emissions.
Task 4.1 Detailed display of product info Task 4.2 Collect feedback from consumers Task 4.3 Notify producers on Consumers' opinion	**Goal 4** Product feedback	**Economic:** ● Increasing the market value of the grapes and wines by providing accompanying information and quality standards. **Social:** ● Legitimise and showcase the social responsibility of local business practices. **Governance:**

		• Allow producers to have agencies on their product marketing and management beyond the retail. **Environmental:** • Have access on yearly basis on the grape and wine lots nutritional , DNA and isotopic data that allows the deployment of environmental friendly practices on the production planning.

Drivers

Tasks	Goal	Driver
Task 1.1 Registration of growing fields Task 1.2 LoRa Network setup and deployment of sensors and IoT devices Task 1.3 Daily accumulation of data from sensors to the cloud data storage Task 1.4 On demand data capturing from grape growers	**Goal 1** Monitoring and data capturing of the fields	**Economical:** • Aim to increase the total local grape and wine production of the region to approach production levels of the past decade **Social:** • Upgrade the wine production business profile of the stakeholders in the region. **Governance:** • Enable the accumulation of a vast array of data that provide a valuable resource in decision making process for the local farmer unions, and local administration and governance agencies. **Environmental:** • Safeguard the natural environment of the region. Grape growing and winemaking is inextricably connected with soil and water quality and establish routines that strengthen the environmental sustainability of the region.
Task 2.1 Terroir identification Task 2.2 Cultivation monitoring and notification provision	**Goal 2** Data analysis and notification system in the wine supply chain	**Economic:** • Re-assessment of the land fields agricultural and market value • Creation, extraction, and acquisition of high value information owned by the actors of the region as a new asset to manage willingly.

Task 2.3 Information flows to winemakers		**Social:** ● Creation of a general sense of local/regional development that affects multiple actors in the region and affects the democratization of information flows and data management across the value chain. **Governance:** ● Increase the data input coming from different entities of Physio-Cyber-Business entities of the region allowing the processing of multidimensional information in planning and decision-making processes. **Environmental:** ● Optimise land utilisation that in turn affects soil and water quality while being energy efficient.
Task 3.1 Establish data flow and information gathering Task 3.2 Identify product & match with product profiles/information using ISO standards Task 3.3 Application of traceability features on the supply chain	**Goal 3** Tracing and product authentication	**Economic:** ● Create links with the thematic wine tourism and associate vineyard development with the broader economic development of the region. **Social:** ● Elevate the local wines to products that hold the protected designation of origin feature upgrading the image of the region. **Governance:** ● Reduce the time and effort needed to execute every-day transactions ● Significantly lower the rate of errors that are currently caused by manual interventions ● Extend, if possible, the application of the traceability platform to additional local agricultural products. **Environmental:** ● Associate the local Wines with international iso standards and environmental management systems

Task 4.1 Detailed display of product info Task 4.2 Collect feedback from consumers Task 4.3 Notify producers on Consumers' opinion	**Goal 4** Product feedback	**Economic:** ● Reach the point where the local wines will hold a share of the niche wine market. **Social:** ● Upgrade the winemaking profile of the region and build reputation in national and later in international markets **Governance:** ● Deploy and utilise a platform that will allow producers to reach and supply other markets without being fully dependent on linear traditional supply chains. **Environmental:** ● Communicate the 'bio' profile of the produced local wines.

Barriers

Tasks	Goal	Impact
Task 1.1 Registration of growing fields Task 1.2 LoRa Network setup and deployment of sensors and IoT devices Task 1.3 Daily accumulation of data from sensors to the cloud data storage Task 1.4 On demand data capturing from grape growers	**Goal 1** Monitoring and data capturing of the fields	**Economic:** ● Non measurable short midterm economic benefits increase the perceived investment risk **Social:** ● Elderly local farmers are reluctant-sceptical towards fast and radical changes in their agricultural routines. **Governance:** ● Lacking governance mechanism to fully handle-exploit the planned digital developments. **Environmental:** ● Increase the electricity demand of the agricultural routines.

Task 2.1 Terroir identification Task 2.2 Cultivation monitoring and notification provision Task 2.3 Information flows to winemakers	**Goal 2** Data analysis and notification system in the wine supply chain	**Economic:** ● Multiple actors from different sectors are involved and capitalize from the benefits of digital services creates complexities on the payments. **Social:** ● Current status dictates that the introduction of new tools and methods is likely to create friction since the digital transformation of grape cultivation and wine production might create winners and losers. ● Farmers and winemakers demand the involvement of an agronomist to act as the intermediary/ Facilitator to perform the actions needed to handle digital tools and pass down the information. **Governance:** ● Challenge to keep in balance the business politics and various interests of actors affected in the region. **Environmental:** ● ---
Task 3.1 Establish data flow and information gathering Task 3.2 Identify product & match with product profiles/information using ISO standards Task 3.3 Application of traceability features on the supply chain	**Goal 3** Tracing and product authentication	**Economic:** ● The perceived economic risks lead smaller local actors to follow simpler procedures due to the fact that market drivers cannot be directly managed and predicted. **Social:** ● The potential participating stakeholders vary in economic resources, human skills and competencies rising challenges in establishing an operational traceability platform across the supply chain. **Governance:** ● The traceability platform is constituted by a multi-layered design involving various IoT modules and apps that increases the complexity, raising extra

		barriers to its adoption and monitoring from the local actors. **Environmental:** ● Potential difficulties for the local winemaking sector to comply with the international environmental quality standards.
Task 4.1 Detailed display of product info Task 4.2 Collect feedback from consumers Task 4.3 Notify producers on Consumers' opinion	**Goal 4** Product feedback	**Economic:** ● Uncertainty on the rate of return of the new additional fixed cost associated with the traceability platform and app service fees. **Social:** ● Risk and uncertainty of market the products in bigger markets and manage consumer feedback through digital space. **Governance:** ● Increased amount of data exchange and accumulated information require the involvement of new skilled personnel to assist with the data management, information processing and digital tools handling. **Environmental:** ● ----

Identification process and observations

The identification process of drivers, barriers and impacts was mainly conducted during the use case workshop where the activities of the workshop aimed, beyond the use case design also to highlight the 'system's' activities and outputs as a useful practice to further understand, the tangible outcomes, actor interactions and ecosystem services. Moreover, the use case workshop has contributed to showcasing the areas where digitisation has contributed or can contribute to the future and how the strengths, weaknesses and idiosyncrasies in this use case context affect the application of targeted digital solutions. The understanding and prioritisation of interests, needs and constraints that originate from individual and context-related background of the local winemaking industry assists the sketching of a use case that aims in the formation of new interactions and promotes solutions that facilitate information flows. Another aim of the workshop was to examine how implicit and explicit

knowledge, values and experiences are shared and if grape growers, winemakers, and other involved actors share a collaborative culture, common interests and goals. Concluding, one of the main targets commonly set throughout all the use case activities was the thorough understanding of the governance scheme (power interactions), dependencies, winemaking administration processes, available human and capital resources as well as understand how current information flows are set and how decision-making processes take place.

Photos and Additional Material

Some photos of the use case workshop and the discussion among key actors can be found below:




General Feedback and Conclusion

This use case constitutes a first exploratory analysis for user-system interaction of the wine making business in Goumenissa village. The strengths, goals and weaknesses of the system were identified, and suitable ICT solutions that could further be registered and utilised through Gnomee DESIRA knowledge base, were proposed to support on field information flows and traceability features on the supply chain of local wine product distribution.

DE use case

The use case proposes a shift from a business-as-usual management of grape growing, wine production and distribution, towards a customised, real-time and network connected data driven management. However, it should be stated that data interpretation, decision support and assistance on the actuation of specific use case tasks are aspects wgere demands should be met in terms of actor's process trust, capabilities, and technical requests, to fully enable the functionalities described. Local grape growers and winemakers call for a wider collaboration with regional authority, scientific, technology and consultancy institutions that operate or have interests in the region, to achieve in common the integration of new insights, methods, and ICT tools in the winemaking processes. Hence this use case served as a testing ground to set the foundations and define the specificities that should be considered before applying in practice digital agricultural tools and services that demand active actor involvement in the winemaking business of Goumenissa. Name of LL (DE)

Living Lab Betzdorf-Gebhardshain, Rhineland-Palatinate (Germany): Between Digital Villages and Online Access Act – Digital Transformation in Rural Areas

Brief summary of LL

The living lab (LL) in Rhineland-Palatinate is situated in the collective municipality of Betzdorf-Gebhardshain, which consists of 17 single municipalities. Betzdorf-Gebhardshain resulted from the fusion of the two formerly separated collective municipalities of Betzdorf and Gebhardshain in 2017 and struggles with problems typical for rural areas in Germany, such as depopulation or limited job and educational opportunities. The LL deals with the opportunities of digitalisation for intensifying exchange between local authorities, citizens, economy and institutions of civil society. The emphasis is put on the administrative perspective, since local administrations - especially in the rural regions of Germany - have not yet exploited the potentials of digitalisation. Even though it has a quite good digital infrastructure, this also applies to Betzdorf-Gebhardshain. For example, many processes in the local administration have not yet been digitalised. But this will change with the "Online Access Act"[8] (OAA) which will affect about 600 different administration services at all levels (from local to federal) that have to be offered digitally by the end of 2022. The OAA is especially challenging for rural administrations due to limited resources, low degrees of technical standardisation, as well as a high degree of disparity in the design of existing digital processes. But, apart from mastering the OAA, Betzdorf-Gebhardshain has the motivation to use digital processes to offer innovative which go beyond mere administrative services for the benefit of its citizens and the local economy. Thus, the living lab's focal question asks, how the local administration can cope with the internal and external challenges of the digital transformation and integrate citizens as well as other local actors into this process.

[8] https://www.onlinezugangsgesetz.de/Webs/OZG/EN/home/home-node.html

LL participants

Potential target groups of the living lab activities included citizens, administration staff, local businesses, volunteers and any other persons interested in the topic. The use case focus group and workshop were promoted and announced in various ways in order to generate attendants. This includes announcements in the official gazette, on local online platforms as well as e-mail distribution lists.

Most participants of the use case activities had an administrative background (educated administrative representatives, administrative staff with other backgrounds, apprentices). The second group included citizens. The professional backgrounds of those participants included the welfare sector, IT as well as retired persons. Furthermore, participants described themselves as citizens doing volunteer work and, in one case, being a member of the city council. The participants' age range spanned from 17 up to 63 years in the group discussion, and from 17 up to 79 years in the workshop.

Timing of Use Case activities

The activities related to the development of the use case were carried out within a time span of two months from mid of March until mid of May 2022. The process started with an internal planning meeting of IESE researchers, reflecting on the results generated in the Living Lab Betzdorf-Gebhardshain so far. In a second step, the ideas collected in this internal meeting were discussed with two representatives of the Living Lab and a range of potential topics for the use case was determined. After the digital stories had been finished, the focus group was conducted in the mid of April. Its results comprised the use case statement, components of the use case as well as a rough draft of task descriptions. Subsequently, the output of the focus group was reviewed and prepared for the use case plenary workshop, which was carried out in the mid of May.

Date / Type	Activity	Duration	Participants and Background	Output
15/03/2022 (Remote)	Internal Planning	1 hour	IESE Researchers	Preparation of Group Discussions
23/03/2022 (Remote)	Discussion	1,5 hours	2 LL Representatives (backgrounds: ICT/administration and communications)	Initial Ideas for Use Case Statement
11/04/2022 (Remote)	Focus Group	2 hours	2 LL Representatives (backgrounds: ICT/administration and communications)	Use Case Statement, Goals, Actors, ICT

			1 Citizen 4 Administration Members (Apprentices) 4 LL Coordinators (background 1st subject: social science, background 2nd subject: mathematics, background 3rd subject: marketing, background 4th subject: data science)	Components, Tasks (Draft)
12/05/2022 (Physical)	Plenary Workshop	4 hours	10 Participants (background: 4 administration members (apprentices), 5 citizens (3 retired, 1 ICT, 1 welfare, 1), 1 member of city council) 2 LL Representatives (backgrounds: ICT/administration and communications) 3 LL Coordinators (background 1st subject: social science, background 2nd subject: mathematics, background 3rd subject: marketing)	Goals, Actors, ICT Components, Tasks, Task Descriptions (Finalised) Drivers, Barriers and Impacts

Use Case Summary

Starting point of the Living Lab's use case "Bringing People Together" was a collection of observations revolving around topics like social live, cohesion and the exchange among citizens. Those observations included aspects such as growing social separation, loneliness, decreasing exchange between generations but also a lack of places and venues where people can meet, interact and do things together. The latter point was articulated as a phenomenon across generations, applying to adolescents as well as elder citizens in the region.

As a result, the idea emerged to design a tool that digitally supports the process of bringing people together physically. Thus, the aim of the use case is to facilitate the personal exchange among people living in the municipality of Betzdorf-Gebhardshain – including groups and individuals who are usually less likely to interact with each other. One emphasis was put on the intergenerational aspect, but also citizens with a migration background were mentioned. Thus, the tool aims at bringing together young as well as elderly people, but also old-established citizens with newly arrived residents.

One crucial point in the discussions was, that nowadays many people do not want to commit themselves in a long-term volunteer work (e.g. in clubs). However, they would be willing to organise single events for the benefit of the community. Therefore, the content and topics, respectively, were defined as the driving force of single events, which can be offered by any individual, in order to meet, exchange, transfer knowledge, do things together and socialise.

Additionally, the question of appropriate locations for such gatherings is actively addressed by the tool. This means that established locations are suggested, but also alternative spaces can be used to host meetings. In addition, the tool is supposed to facilitate outdoor activities such as hiking tours or the exploration of the region's natural environment. This potentially could be extended by elements of gamification.

Summing up, the use case is supposed to support integration and social life in the region by facilitating the preparation, realisation as well as post-processing of events and assemblies.

Use case statement

Final version: The goal of the system is to bring citizens of different generations and backgrounds together at alternating locations and based on different topics with the intention to foster communication, exchange of knowledge and joint activities. The system relies on a web application, assuring a high degree of usability on mobile and stationary devices, features geo-functionalities and has interfaces to existing digital services provided in the region.

Use case statement development and observations

Based on the Living Lab topic and results generated in the previous DESIRA activities in Betzdorf-Gebhardshain (especially the socio-cyber-physical system of processes of exchange between public and private actors in Betzdorf-Gebhardshain and the two fictional digital stories dealing with services of public interest) a range of potential topics for the use case was assembled by the Living Lab coordinators of Fraunhofer IESE. This initial range of topics was discussed with the Living Lab representatives and extended, leading to the following list:

- Civic participation
- Integrating administrative services following the Online Access Act (OAA) into the existing application DorfFunk
- Reducing social separation/isolation

- Facilitating third spaces
- Supporting clubs and volunteers

This range of topics was used to reflect on the situation in Betzodrf-Gebhardshain rather than pre-defining the use case.

The use case statement was developed by the participants of the focus group. After reflecting on the two digital stories created in Betzdorf-Gebhardshain, the question "What can we do in Betzdorf-Gebhardshain today in order to follow the positive scenario's pathway?" was discussed. The responses were collected in the form of key points. Afterwards, the main issue was consensually determined by the participants. The step from this general topic to the use case statement was promoted by the question "What could be the title of our use case?". After the participants agreed on "Bringing People Together" the use case statement was formulated step by step discussing the system's purpose, relevant actors and components.

Use Case Elements

Element	List
Actors	• **Citizens (1):** comprising different age groups, different backgrounds (locals, new locals, migration background) and different interests • **Clubs (2):** institutions/associations of civil society which are formalised and established usually with a certain topical background • **Initiatives (3):** more lose forms of existing communities with certain interests and topical backgrounds • **Educational institutions (4):** such as schools, preschools, adult education centres, both, as institutions as well as their members (teachers and students) • **Administration (5):** the local administration of the municipality of Betzdorf-Gebhardshain and its members • **External information sources (6):** newspapers, local gazette, event sector
Goals	• **Offering an event (1):** all persons registered (users) are able to publicly discuss topics, seek for allies and offer evens • **Activating participants (2):** information and feedback functionalities allow organisers of events to invite other users and receive suggestions • **Supporting an event (3):** in addition to the setup and preparation of events, the system also supports the organiser as well as participants with the realisation of an event

	• **Documenting an event (4):** events facilitated by the system can be documented and publicly reported

Tasks	• **Goal 1: Offering an event**
	  ○ **Task 1.1 Discussing topics:** users are given the opportunity to bring up and challenge ideas for events
	  ○ **Task 1.2 Defining a topic:** users willing to host an event are given the opportunity to set and publish the main parameters of their event
	  ○ **Task 1.3 Finding a location:** the system supports organisers in finding or defining appropriate locations for their events
	  ○ **Task 1.4 Finding support/experts:** organisers can seek for allies helping them to realise their events
	• **Goal 2: Activating participants**
	  ○ **Task 2.1 Inviting individuals and groups:** information on and parameters of events can be communicated within the system to generate participants
	  ○ **Task 2.2 Suggesting adjustments:** users of the system can comment on planned events and make suggestions e.g. to improve them
	  ○ **Task 2.3 Indicating attendance:** users of the system can indicate their interest (or disinterest) in events
	• **Goal 3: Support realisation of the event**
	  ○ **Task 3.1 Navigation to event location:** events may take place in locations unknown to participants or be carried out in motion
	  ○ **Task 3.2 Provision of polls:** sometimes it is necessary to provide a tool to ask participants for their opinion
	• **Goal 4: Documentation of the event**
	  ○ **Task 4.1 Define roles for participants:** to support the organisers, optional rules (photographer, reporter) can be defined to reduce the effort for the organiser
	  ○ **Task 4.2 Taking pictures and videos:** the system supports taking pictures of the event for the report
	  ○ **Task 4.3 Creating a report:** somebody writes a report of the event
	  ○ **Evaluate the event (4.4):** participants can evaluate the event and share their experience

	○ **Publishing the material (4.5):** the report including the pictures can be published in the tool and via different external channels
ICT Components	• **Web Application (1):** publicly accessible with individualised accounts, allows for goals 1, 2, and 4 • **Geo-Functionality (2):** allows for goal 3 • **Devices (3):** users' mobile and stationary devices on which component 1 and/or 2 are executed • **Existing Interfaces (4):** online services already established in the region • **Camera or smartphone (4)**: allows for goal 4

Elements identification process and observations

The elements of the use case were developed iteratively – most of them during the focus group. The alternation between identifying the most relevant issue, the possible title of the use case and its goals was particularly productive. So, it was possible to add actors and components step by step. The tasks were only roughly determined during the focus group by collecting features the system would need to provide in order to fulfil the goals.

Task Descriptions

Tasks

GOAL 1 (Offering an event)

- **Task Name:** discussing topics *(task 1.1)*
- **How is this performed right now?**
  - topics are discussed primarily by existing groups and institutions, if at all
- **Which are the weaknesses/issues of the current approach?**
  - topics of possible events in the region are only seldomly discussed publicly
  - individuals who are not part of groups and institutions are not given the opportunity to develop topics for events
  - potential ideas get lost or are not realised
- **How can this be supported by an ICT system / digital tool?**
  - Users (citizen and members of institutions) discuss topics and ideas publicly in order to assess their potential for an event
- **Actors Involved:** list the actors that are involved in this task
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration

- **ICT components:**
  - Web application
  - Interaction space (posts, chat room, groups, forum)

- **Task Name:** defining a topic (task 1.2)
- **How is this performed right now?**
  - Established actors and institutions (clubs, schools, cultural scene) define topics
  - Established actors define the region's 'programme'
- **Which are the weaknesses/issues of the current approach?**
  - The region's programme is defined from above
  - Topics are following the agendas of institutions
  - The regions programme is little diverse
- **How can this be supported by an ICT system / digital tool?**
  - An individual user (citizen or member of an institution) creates an event with a defined topic to make it public
- **Actors Involved:** list the actors that are involved in this task
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
- **ICT components:** list the ICT components involved in this task
  - Web application
  - Input form

- **Task Name:** finding a location *(task 1.3)*
- **How is this performed right now?**
  - Actors offering events do have the necessary facilities
  - Actors without the necessary facilities have find appropriate ones e.g. by asking
- **Which are the weaknesses/issues of the current approach?** Please list the weaknesses of the current approach, which lead to the need to introduce an ICT system / digital tool
  - Finding appropriate facilities requires knowledge (opportunities or intermediaries)
  - Organising an appropriate facility can be time consuming
  - An overview of facilities does not exist
- **How can this be supported by an ICT system / digital tool?**
  - An individual (citizen of member of an institution) choses from a list of suggestions to select an appropriate location/facility for the event
- **Actors Involved:** list the actors that are involved in this task
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
- **ICT components:** list the ICT components involved in this task
  - Web application
  - Drop down list of locations
  - Data base containing venues with various properties

- **Task Name:** finding support/experts *(task 1.4)*

- **How is this performed right now?** Please describe how the task is performed right now
  - People supporting an event are recruited within the organising institution
  - People supporting an event are recruited in personal networks (friends, family)
  - Recruiting is realised in face-to-face meetings or using channels of internal communication
- **Which are the weaknesses/issues of the current approach?** Please list the weaknesses of the current approach, which lead to the need to introduce an ICT system / digital tool
  - Resources are limited to organising institutions and personal networks
  - Individuals supporting an event often comprise "the usual suspects"
- **How can this be supported by an ICT system / digital tool?**
  - The organiser manually selects users of the system to request support for the event
  - The system requests potentially interested users based on a matchmaking process (users' and event's profiles) in order to find supporters
  - The organiser ads a personal message to address users selected by the system based on a matchmaking process (users' and event's profiles) in order to generate commitment
- **Actors Involved:** list the actors that are involved in this task
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
  - Roles: organiser and system
- **ICT components:** list the ICT components involved in this task
  - Web application
  - Messaging function
  - Individual user profiles
  - Event profiles
  - Matchmaking functionality

GOAL 2 (Activating participants)

- **Task Name:** inviting individuals and groups *(task 2.1)*
- **How is this performed right now?**
  - Event marketing via traditional channels (print media, posters, flyer)
  - Event marketing via digital channels (website, social media)
  - Word-of-mouth inside and outside of institutions
- **Which are the weaknesses/issues of the current approach?**
  - Usual event marketing is rather boring
  - Usual event marketing is to some degree imprecise
- **How can this be supported by an ICT system / digital tool?**
  - The organizer uses the system to address possible target groups directly within the tool in order to promote the event
  - The organizer uses the system to create appropriate marketing material for external channels in order to promote the event
- **Actors Involved:** list the actors that are involved in this task
  - Citizens

    - Members of clubs, initiatives, educational institutions, and the local administration
    - Members of external information sources
    - Roles: organiser, users and system
- **ICT components:** list the ICT components involved in this task
    - Web application
    - Messaging/notifying functionality
    - Interfaces to existing digital services

- **Task Name:** suggesting adjustments *(task 2.2)*
- **How is this performed right now?**
    - Except from the phase of internal and initial event preparations, adjustments are nor possible or happen accidentally
- **Which are the weaknesses/issues of the current approach?**
    - Non-existent feedback and adjustment opportunities can lead to the failure, cancellation or even termination of events
- **How can this be supported by an ICT system / digital tool?**
    - Users of the system can publicly address the organiser with suggestions to improve an event
    - Users of the system can comment suggestions and/or make indications to express approval or disapproval
    - The organiser can accept or decline suggestions to improve the event
    - The organiser can activate or deactivate the suggestions feature to prevent extensive discussions or to avoid suggestions which cannot be realised anymore
- **Actors Involved:** list the actors that are involved in this task
    - Citizens
    - Members of clubs, initiatives, educational institutions, and the local administration
    - Roles: organiser, users
- **ICT components:** list the ICT components involved in this task
    - Web application
    - Settings feature for suggestions
    - Suggestions feature (comments, approval, disapproval)

- **Task Name:** indicating attendance *(task 2.3)*
- **How is this performed right now?**
    - Attendance can be indicated via registration, presale of tickets, word-of-mouth, via social media
    - Often, the indication of attendance does not take place
    - Attendance is indicated directly by actually participating in an event
- **Which are the weaknesses/issues of the current approach?**
    - Organisers of events cannot estimate the number of participants in advance
    - Organisers cannot evaluate the public's interest in an event in advance
    - Without information on the number of participants, events are hard to plan
- **How can this be supported by an ICT system / digital tool?**

    - Users of the system gradually indicate their intention to participate to inform the organiser and other users
- **Actors Involved:** list the actors that are involved in this task
    - Citizens
    - Members of clubs, initiatives, educational institutions, and the local administration
    - Roles: organiser, users
- **ICT components:** list the ICT components involved in this task
    - Web application
    - Devices
    - Feature to indicate participation

GOAL 3 (Supporting an Event)

- **Task Name:** Navigation to event location *(task 3.1)* navigate participants to locations where there is no address available
- **How is this performed now?**
    - Self-organisation of the participants
    - Use of navigation systems
- **Which are the weaknesses/issues of the current approach?**
    - Not all people who can participate do actually participate
    - There is no intuitive interface to common navigation systems
- **How can this be supported by an ICT system / digital tool?**
    - The participants navigate themselves to the event location in order to participate the event
- **Actors involved**:
    - Citizens
    - Members of clubs, initiatives, educational institutions, and the local administration
    - Roles: users
- **ICT components:**
    - Interfaces and plugins
    - Mobile phone or navigation systems

- **Task Name:** Provision of polls *(task 3.2)*: the participants can give a “thumps-up” or a “thumps-down” to indicate if they liked the even *(task 3.2)*
- **How is this performed now?**
    - External tools with voting functions
    - For example: Mentimeter, Jotforms, etc.
- **Which are the weaknesses/issues of the current approach?**
    - The polls are external tools
    - This requires extra effort to create, evaluate and export the results
- **How can this be supported by an ICT system / digital tool?**
    - The organiser of the event provides a poll for the participants in order to get feedback/opinion of the event
- **Actors involved**:
    - Citizens
    - Members of clubs, initiatives, educational institutions, and the local administration
    - Roles: organiser, users

- **ICT components:**
  - Interfaces and plugins
  - Smartphone, tablet, Desktop-PC

GOAL 4 (Documentation of the event)

- **Task Name:** Define roles for participants *(task 4.1)* in case you want to create and publish a report of the documents it is useful to define roles for the event
- **How is this performed now?**
  - Publish reports of an event in social media (e.g. Facebook)
  - Local administration publishes reports on the homepage
  - Press coverage
- **Which are the weaknesses/issues of the current approach?**
  - Not everyone can share a report
  - Therefore, not everyone gets informed of what is happening in the community
  - There is a need to have the roles "organiser", "photographer", "report writer", "participant" (whereby "organiser" and "participant" already exist)
  - The roles "photographer" and "reporter" are optional, the organiser can take the roles by himself
- **How can this be supported by an ICT system / digital tool?**
  - The organiser of the event defines special roles for the participants in order to get support to create and publish a report of the event
- **Actors involved**:
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
  - Roles: organiser, users
- **ICT components:**
  - Smartphone, tablet, Desktop-PC

- **Task Name:** Taking pictures and videos *(task 4.2)* during an event, somebody takes the role of a photographer – suggested by the organiser and agreed to do so – and takes pictures or maybe even short videos of the event
- **How is this performed now?**
  - Self-organized: everyone takes their own pictures and shares them in social media platforms
- **Which are the weaknesses/issues of the current approach?**
  - The organiser cannot focus 100% on the realisation of the event because he needs some extra time to take pictures of the event
  - The attention is not primarily on the participants, the actual content of the event gets lost
  - No photos are taken
- **How can this be supported by an ICT system / digital tool?**
  - The photographer of the event documents the event by taking pictures in order to support public relation activities
- **Actors involved**:
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
  - Roles: photographer
- **ICT components:**

- Smartphone, camera

- **Task Name:** Creating a report *(task 4.3)* during an event, somebody takes the role of a reporter – suggested by the organiser and agreed to do so – and creates a report of the event
- **How is this performed now?**
  - Self-organized: everyone shares reports individually in social media platforms
  - Print media
- **Which are the weaknesses/issues of the current approach?**
  - Print media (daily/weekly news) are publications with delay
  - Some events are not even published at all in the print media, though it would be desirable to do so
  - The organisers have no influence on the type of publications, i.e. where they will be published and by whom
  - In social media there is no pooling or bundling of the events and their reports, a hashtag function should be available
- **How can this be supported by an ICT system / digital tool?**
  - The reporter of the event creates a report in order to inform about events
- **Actors involved**:
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
  - Roles: reporter, users
- **ICT components:**
  - Smartphone, tablet, PC

- **Task Name:** Evaluate the event *(task 4.4)* after an event, the participants should be able to provide an evaluation of the event
- **How is this performed now?**
  - Happening, but not in a public way
  - Possible for social media
  - Private
- **Which are the weaknesses/issues of the current approach?**
  - Subjective choice of people who provide an evaluation → biased feedback
  - Some people feel left behind, other people cannot access the report
  - Loss of people who would join an event if they would see positive reports
- **How can this be supported by an ICT system / digital tool?**
  - The participants of the event evaluate the event in order to provide feedback of the event (whether it was a positive one or not) by a thumps-up functionality
- **Actors involved**:
  - Citizens
  - Members of clubs, initiatives, educational institutions, and the local administration
  - Roles: participants
- **ICT components:**
  - Smartphone, tablet, PC

- **Task Name:** Publishing the material *(task 4.5)* after an event, the organiser can decide on which platforms the report will be published and confirms where it is published
- **How is this performed now?**
  - Not possible on a personal level

    - only authorised people like administration workers
- **Which are the weaknesses/issues of the current approach?**
    - The report is there, but needs to be inserted manually
    - Use of copy-paste helps, but no automated process
    - In particular, there is no function to provide reports for the local gazette of the municipality of Betzdorf-Gebhardshain
- **How can this be supported by an ICT system / digital tool?**
    - The organiser of the event chooses where the report is published (and where not) in order to inform the public
- **Actors involved**:
    - Citizens
    - Members of clubs, initiatives, educational institutions, and the local administration
    - Roles: organiser
- **ICT components:**
    - Smartphone, tablet, PC

Task description process and observations

In the workshop, we provided a preliminary spreadsheet of the use case's goals, listing the tasks, based on the focus group. The tasks were discussed and edited. For task 3, e.g. we defined four subtasks before the workshop, but it turned out that there is only a need for two subtasks. To complete the task descriptions, we divided the participants in two groups and each group worked on two goals with the relevant tasks.

An extensive discussion revolved around task 4. First of all, the participants suggested to define more roles (i.e. user roles which are separate from the use case's actors and have been added to the task descriptions) for this task to clarify who is responsible to do what. Hence, we added the task "Define roles for participants". It took some time to distinguish between creating, publishing and sharing a report. There was a longer discussion on how the procedure of task 4 should work. In particular, the point when a report should be shared to the public relation news was crucial.

The workshop revealed that there is a need for an easy way to create reports of events. In particular, it is not desirable that there is no central point to publish the reports. This means that reports are shared either individually in social media platforms like Facebook or in print media with some delay. In other words, the general public is not informed in a holistic way about the events in the community. But this is important to motivate people to participate or even to organise an own event.

Impacts, Drivers and Barriers

Impacts

Tasks	Goal	Impact

Task 1.1: Discussing Topics Task 1.2: Defining a topic Task 1.3: Finding a location Task 1.4: Finding support/experts	**Goal 1:** Offering an event	**Economical**: ● - **Social**: ● New contacts: the system brings people together, creating new acquaintances and friends ● Offerings: more and more diverse events are offered ● Abuse: the system bears the risk of being misused, e.g. for inappropriate purposes **Governance**: ● Political purposes: system might be used for campaigning by the decision makers who introduced it ● Political events: system might be used to offer political events during campaigns **Environmental**: ● Ecological benefits: events concerning ecological topics might lead to improvements (e.g. discussing and improving the public transportation system) ● Ecological damages: improper use may cause harm (e.g. large crowds meeting in nature, littering) **Technological:** ● Development: usage of the system leads to furthers needs, ideas and new features
Task 2.1: Inviting individuals and groups Task 2.2: Suggesting adjustments Task 2.3: Indicating attendance	**Goal 2:** Activating participants	**Economical**: ● Food service industry: events have a positive effect on local restaurants and bars **Social**: ● Attitudes: activation of participants and discussion of possible events might change attitudes ● Group effects: participation in events becomes more likely when others indicated their attendance ● Generations: activation might happen across generations

		• Feedback: feedback channels allow for better planning of events • Knowing the region: learning about events in different locations generates regional knowledge • Event diversity: easy planning results in more events • Sociality and cohesion: participation in events improves togetherness and cohesion • Confirmation: feedback generates confirmation and feelings of success **Governance**: • - **Environmental**: • Topic related events: arranging meetings with positive environmental effects (nature and animal protection) and raising awareness **Technological:** • -
Task 3.1: Navigation to event location Task 3.2: Provision of polls	**Goal 3:** Supporting an Event	**Economical:** • Get to know new (software) tools • Community gets more attractive for people outside the community • Better networking within the community via current events **Social:** • Community gets more attractive for people outside the community • Better networking within the community via current events • More holding together in the community & social welfare system • Discover new places in the region • Better bond between the generations

		• Marginalised groups/interests that are not in the focus of being invited by others nowadays become even less visible • More participation (more participants in the event and as helpers in the event) • Try out new things with new friends **Governance:** • The "getting into conversation" is partly digitised • The new [i.e. not yet founded] Federal Digital Department is interested in the tool **Environmental:** • Save resources
Task 4.1: Define roles for participants Task 4.2: Taking pictures and videos Task 4.3: Creating a report Task 4.4: Evaluate the event Task 4.5: Publishing the material	**Goal 4:** Documentation of the event	**Economical**: • Financial barriers become lower in order to hold events. • The supra-regional awareness of the region is increasing. **Social**: • Growing pool of participants • Experiences how to organise an event are recorded • More young participants • Save time in public relations work • Growing of offers after some time • More participants by positive reviews • Sources of reports/news **Governance**: • The supra-regional awareness of the region is increasing. • Events become more visible • Sources of reports/news **Environmental**: • More data garbage

		• The Dirt Clean-up Day [“Dreck-Wegmachtag”, a local action day to remove dirt in the community, see e.g. https://www.siegener-zeitung.de/betzdorf/c-lokales/schnee-beim-dreck-wegmach-tag_a270788] gets more attention

Drivers

Tasks	Goal	Driver
Task 1.1: Discussing Topics Task 1.2: Defining a topic Task 1.3: Finding a location Task 1.4: Finding support/experts	**Goal 1:** Offering an event	**Economical**: • Sponsoring: offering events (and the system itself) might benefit from regional sponsors • Attractiveness: broader range of events offered makes the region more attractive **Social**: • Fans: people who are fond of events and who are tiered of COVID 19 might use and promote the system **Governance**: • - **Environmental**: • - **Technological:** • Quality: good usability leads to better flow of work making the planning of events easier
Task 2.1: Inviting individuals and groups Task 2.2: Suggesting adjustments	**Goal 2:** Activating participants	**Economical**: • - **Social**: • Event multiplier effect: events with many participants have positive effects on future events • Person multiplier effect: mutual motivation to participate generates more participants

Task 2.3: Indicating attendance		• Feedback: feedback opportunities make planning easier • Level of awareness: positively influences the success of the system and events **Governance**: • - **Environmental**: • - **Technological:** • Usability: good usability and performance has positive effect on attendances (and vice versa)
Task 3.1: Navigation to event location Task 3.2: Provision of polls	**Goal 3:** Supporting an Event	**Economical:** • Support of administration and associations, for example signposts • All components of the tool fulfil GDPR (General Data Protection Regulation) requirements • Use of open data (or open data interfaces) • Increasing effectiveness by reducing the project coordination for community organizers **Social:** • reward system • Making community experience with a low barrier • Public relations work before starting an event supports because there will be more people and the execution of an event becomes easier • Support of administration and associations, for example signposts • All components of the tool fulfil GDPR requirements **Governance:** • digital policy agenda **Environmental:** • Save paper (less need for printing)

Task 4.1: Define roles for participants Task 4.2: Taking pictures and videos Task 4.3: Creating a report Task 4.4: Evaluate the event Task 4.5: Publishing the material	**Goal 4:** Documentation of the event	**Economical**: ● Hire of technology for events ● Voluntary reporters ● Prompt public relation work ● Easier public relation work by having more interfaces **Social**: ● Hire of technology for events ● Voluntary reporters ● Prompt public relation work ● Easier public relation work by having more interfaces ● Reward system ● Acknowledgement of efforts ● Organisers provide smartphones to avoid discussions on “who has the best camera” **Governance**: ● - **Environmental**: ● Hire of technology for events ● Printed documents play a minor role for events in fields/forests

Barriers

Tasks	Goal	Impact
Task 1.1: Discussing Topics Task 1.2: Defining a topic Task 1.3: Finding a location	**Goal 1:** Offering an event	**Economical**: ● Sponsoring: sponsoring might prevent people from using the system for offering events **Social**: ● Feedback: fear of negative feedback might hinder people offering events

Task 1.4: Finding support/experts		• Accessibility: poor accessibility of the system might restrict the circle of users • Competitiveness: people might fear competition of other/better events • Exclusion: the system might not reach all groups of citizens (e.g. elders) **Governance**: • Regulations: regulations such as security requirements or data protection might keep people from using the system and offering events **Environmental**: • - **Technological:** • -
Task 2.1: Inviting individuals and groups Task 2.2: Suggesting adjustments Task 2.3: Indicating attendance	**Goal 2:** Activating participants	**Economical**: • Financial aspects: cost of any sort might inhibit the use of the system as well as the participation in events **Social**: • Description: poor descriptions of events might reduce participation • Overabundance: too many events result in diffusion of participants • Unreliability: discrepancy between feedback in system and actual participation in events might be demotivating for organisers **Governance**: • Political risks: high level of prominence attracts political risks (extremist groups, violators) **Environmental**: • - **Technological:** • Disabilities: physical disabilities might hamper the use of the system

Task 3.1: Navigation to event location Task 3.2: Provision of polls	**Goal 3:** Supporting an Event	**Economical:** ● No interfaces available, they need to be customized ● Changes of external tools ● Policies must enable connection and broadband to be possible (the infrastructure must be provided) ● The tool must be built in a way that the mobile data volume is not wasted for nothing ● Legal aspects of the integration of external tools **Social:** ● GPS data are tracked, privacy not guaranteed ● Not enough volunteers, helpers, organisers ● Experience/skills with digital tools is not sufficiently present for some people **Governance:** ● Policies must enable connection and broadband to be possible (the infrastructure must be provided) ● The tool must be built in a way that the mobile data volume is not wasted for nothing ● Legal aspects of the integration of external tools ● Privacy, framework conditions of GDPR **Environmental:** ● -
Task 4.1: Define roles for participants Task 4.2: Taking pictures and videos Task 4.3: Creating a report Task 4.4: Evaluate the event	**Goal 4:** Documentation of the event	**Economical**: ● Interfaces to export data not available ● Keep privacy regulations ● Somebody who has a newer smartphone can take better pictures (better camera) **Social**: ● Keep privacy regulations ● Somebody who has a newer smartphone can take better pictures (better camera) ● Possibly there will be discussions on who gets which role (task 4.1)

Task 4.5: Publishing the material		• Not enough experience with social media, fear of using social media • Fear of a negative evaluation • Evaluations promote uncertainty • Much unnecessary video material • No volunteers for writing reports/taking pictures/making videos, difficult to find some • Holding an event is an additional burden for the organiser and discourages the holding of the event **Governance**: • Keep privacy regulations • Subjective reports without providing more context/classification **Environmental**: • * Digital form of materials (Server Systems that need electricity)

Identification process and observations

To define impacts, drivers and barriers, we divided the participants in two groups and each group worked on two goals with the relevant tasks. For each goal, a poster was prepared containing a big circle with four sections standing for economical, social, environmental and governance aspects. In of the two working groups, technological aspects were added as a fifth category. Then, impacts, drivers and barriers were collected on different-coloured slips of paper, discussed and sticked to the poster.

Some impacts, drivers and barriers were mentioned in two or even three categories, being hard to distinguish because they affect more than one category.

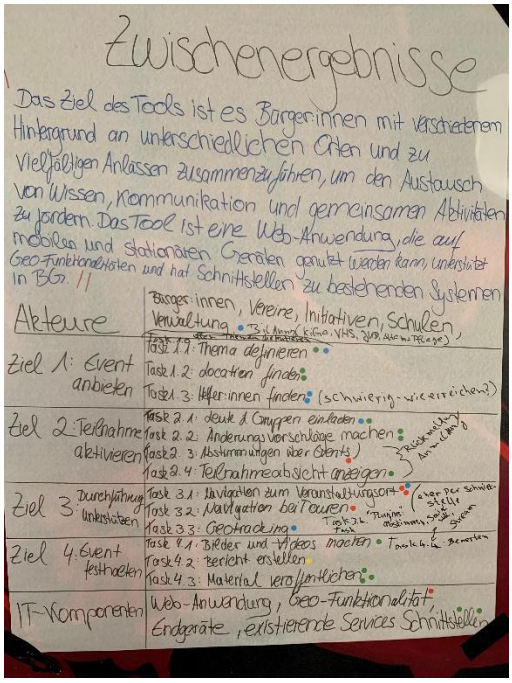
Generally speaking, the tool stands and falls with the willingness of volunteers. In case that not enough volunteers can be found, it makes no sense to plan and implement events. Another major problem for the realisation of such kind of tool are privacy regulations as there will be taken pictures, which are published publicly. Though we did not specify how such a reward system could look like, a reward system could motivate people to organise and hold events.

When working on task 4.4 with the participants we had a longer discussion about manipulation. In some sense, sharing events with the opportunity for feedback must be investigated carefully. Some important points that were mentioned include: 1) not everyone is familiar in communicating in social media and therefore their comments might not be appropriate, 2) event organisers might fear negative public feedback, 3) participants will possibly hesitate to give an honest feedback in case they

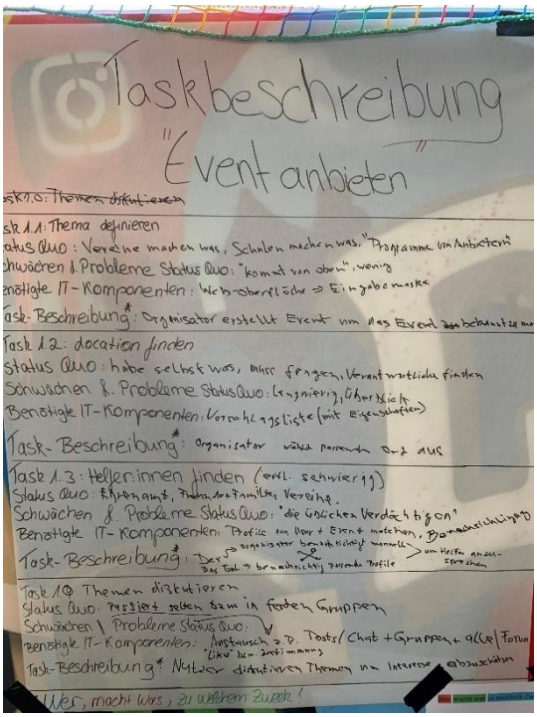
made a bad experience during an event. It is ad-hoc not clear how a public evaluation of an event will influence the behaviour of the users of the tool. Also, this issue will depend on how detailed the evaluation will work. A simple “thumps-up” function has another influence than an evaluation function that allows comments.

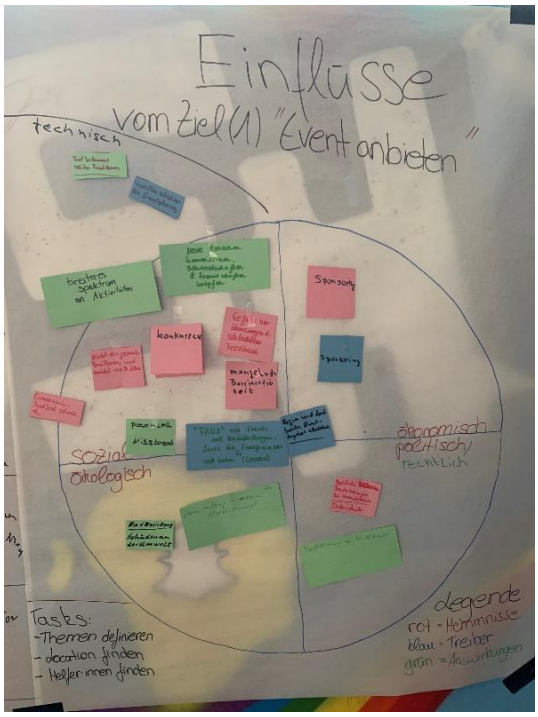
Photos and Additional Material

A table with the use case statement with a draft version of the goals and (sub-)tasks:

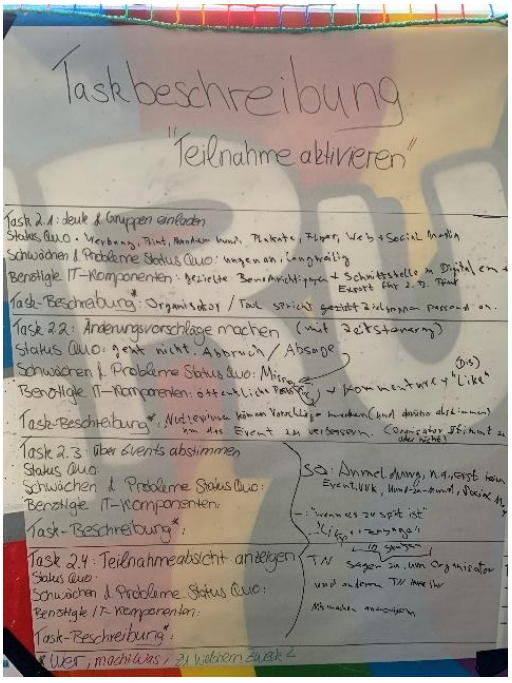


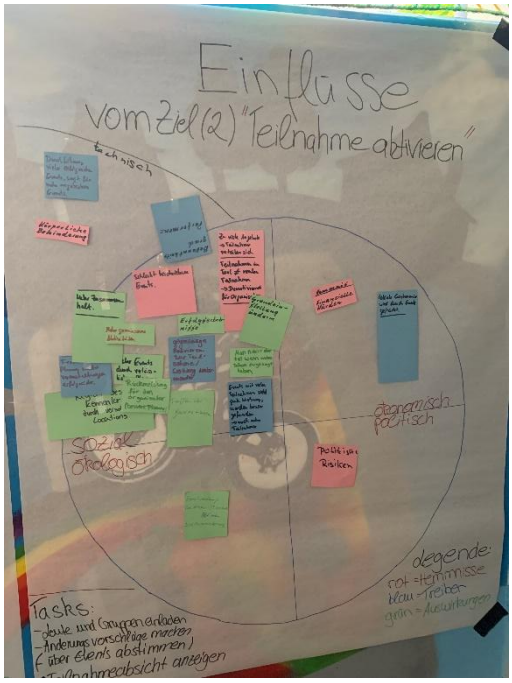
Goal 1 (task description and impacts):



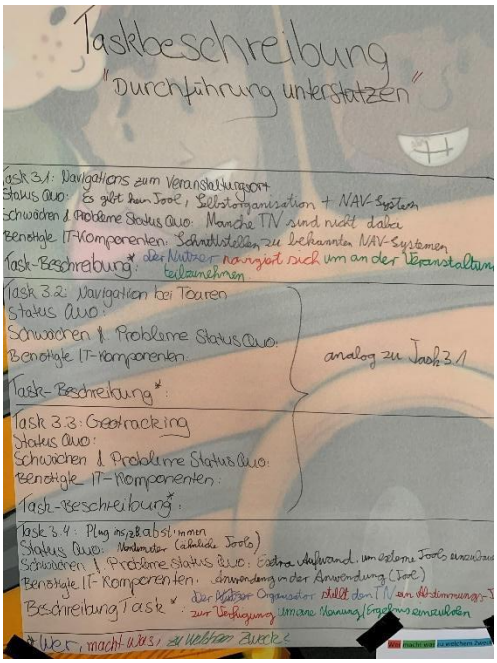


Goal 2 (task description and impacts):

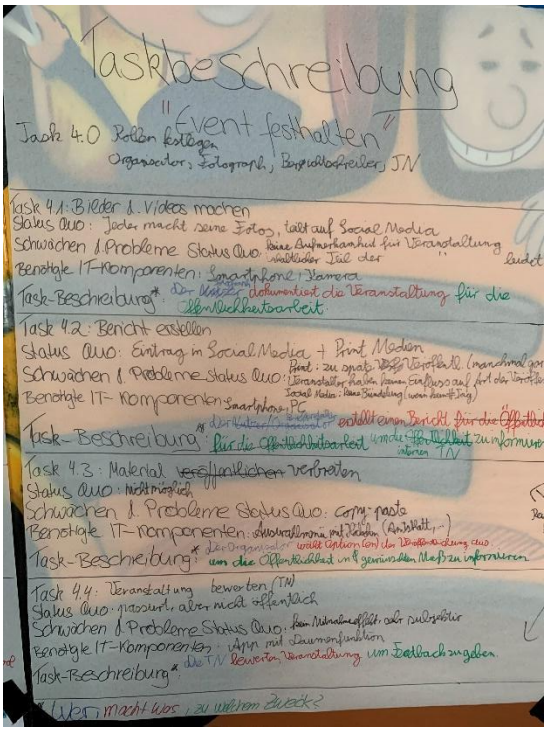




Goal 3 (task description and impacts):



Goal 4 (task description and impacts):



Discussions during the workshop:


ENFAHRT

General Feedback and Conclusion

To conclude, the use case developed in the Rhineland-Palatinate Living Lab "Bringing People Together" is to some degree surprising, since it does not directly refer to the administration and its typical tasks. However, the topic of digital transformation in rural administrations still is represented in the use case on a rather general level in the sense that the focus was since the beginning on processes of exchange and social aspects. Additionally, the local administration itself could be using the suggested system as a registered institution and furthermore could be integrated through, e.g. a feature for booking public facilities. Thus, the system can be regarded as an instance of a public service that extends the field of the administration's activities.

One prevalent question was if the use case would refer to the extension of existing digital services offered in Betzdorf-Gebhardshain, such as DorfFunk (regional social media app), DorfNews (regional news tool) or LösBar (tool for dialogue between administration and citizens). The result of the use case is a new tool, which features several interfaces for those existing services. That those interfaces were brought up by the participants, implies that digital services are increasingly imagined within the framework of a digital ecosystem. In fact, the use case could technically be integrated into the existing Digital Villages Platform (*Digitale-Dörfer-Plattform*).

Aside from those rather content related aspects, the development of the use case was methodically successful. It was easy to reach a sufficient number of participants for both, the focus group as well as the workshop. It can be assumed that the use case development was not only communicated but also perceived as a rather practical and hands on activity. This also was mirrored in the two events which were characterised by a high degree of participation and participants' input.

The combination of a three-step approach (meeting with LL representatives, focus group, workshop) also can be regarded positive. The task descriptions admittedly could not be finished in the course of the focus group, but this turned out to be an advantage: Developing the task descriptions in the workshop added more variety to the event and increased its applied character: A workshop of four hours exclusively concentrating on impacts, drivers and barriers certainly would have been very challenging and lacking in variation, especially for the participants.

Acknowledgements:

We would like to thank our colleague Fabienne Hammer for her valuable comments.

SCO use case

LL Coigach Scotland

Brief summary of LL

The LL has explored the importance of digital technologies to the Coigach Crofting community and how these might shape the community in the future. As parting interactive workshops to gather experiences and record input on the research, we have carried out several activities, including potential changes that might transform the community by 2031. We have involved participants who would like to share their thoughts on these topics in particular people with an active role in supporting or participating in crofting and crofting communities.

The participants of the LL consisted of active community members who were available to share their thoughts during the workshops. All community members are pluriactive with several jobs and incomes to support their families and their lives in the Coigach peninsular. In addition members of organisations actively involved in the community in projects, funding activities and land management were invited to join, including those representing support agencies and the Scottish Government. Not all participants were able to join all the activities. We had a flexible membership that accommodated the availability of stakeholders and community members.

Timing of Use Case activities

- Initial group discussion with Crofting Federation Training Manager (12/2019)
- LL discussion in workshop
- Various discussion sessions - see below for details

Date / Type	Activity	Duration	Participants and Background	Output
12/2019 (in person)	Discussion	2 hour	Crofting Federation Training Manager	Training for crofters
04/2021 (Hybrid)	Workshop discussion	1 hour	LL participants	Initial identification of ideas to support training opportunities
05/2022 (virtual)	Email exchange	5 emails	Various actors	Identifying actors and potential problems of

				training for crofters
05/2022 (Virtual)	Discussion	2 hours	Crofting commission	Wide discussion on engaging crofters with training, barriers and challenges
05/2022	Discussion	2 hours	Crofting Federation	Wide discussion on engaging crofters with training, barriers and challenges

Use Case Summary

Providing information on training opportunities for Crofters in isolated communities, and often remote from these communities, has proved challenging. The remote geographical locations of many of the crofters means they often don't have a central point of contact. In the past, the communities gathered at the local community hall and the hall notice boards would advertise training opportunities, especially since Covid-19 this is less often the case and other means have had to be used to reach out to them. More recently farming/crofting organisations have used newsletters to notify people of training opportunities. Currently, notifications are advertised on webpages, social media (including Facebook; twitter and YouTube) and local community websites. However, it has proved challenging to engage crofters and take up of opportunities can be limited. Using gamification the James Hutton team hopes to develop a tool as part of the DESIRA project that can entertain players whilst informing them about training opportunities.

In addition Crofters (and smallholders) find it time-consuming to search for appropriate training opportunities. Some courses are only open to members of organisations therefore access is not equal for all, only those with registered crofts can access courses open to crofters, excluding all smallholders. Many courses advertised are for rural dwelling people that don't own land and are not useful to crofters and smallholders, e.g., fencing for a garden is very different to stock fencing and the courses are equally different. People spend many hours using all their resources to find appropriate training, at a convenient time and an accessible location.

The DigiTool hopes to deliver clear messages that are focused within a unique environment targeted to engage the crofting (and smallholding) community. A simulated crofting community environment will be developed by a software developer that will be augmented with 360-degree footage to allow a bespoke experience to be created. The information spheres will deliver information on training opportunities to engage players and inform them on the background of the topic as well as directing them to event pages giving times and dates of training opportunities, allowing players to register their

interest. The game will also provide lasting resources that offer learning experiences as well as informing them of events that they can engage with.

Use case statement

Use case statement: *the goal of the system is to provide information on training opportunities on one platform (signposting) using gamification techniques to engage and entertain players. The system relies on a simulated environment and 360-degree footage with embedded resources to inform players of the game. Feedback surveys will be embedded to collect information to improve the DigiTool.*

Use case statement development and observations

The Use case statement was defined following discussions and engagement with LL participants. Following subsequent discussion sessions with expert actors from interested stakeholder organisations, the statement was refined to reflect these discussions.

Use Case Elements

Element	List
Actors	• **Crofting Federation:** Training development officer • **Crofting commission Actor 1:** Crofting Development Officers, part of the crofting community-focused Crofting Development Team. • **Crofting commission Actor 2**: Crofting Development Officers, part of the crofting community-focused Crofting Development Team. • **Crofting Federation:** Chief executive • **Scottish Government representative** • **Farm Advisory Service**
Goals	• Engage crofters with training • Point crofters to potential training opportunities • Collect feedback on training opportunities

Tasks	• **Goal 1: Engage crofters with training**
	  ○ **Task 1.1. Identify current ways to engage crofters with training opportunities**
	  ○ **Identify barriers**
	  ○ **Identify challenges**
	  ○ **How to overcome these?**
	• **Goal 2: Point crofters to potential training opportunities**
	  ○ **Task 1.2. Identify how to best guide crofters to potential training opportunities**
	  ○ **Identify barriers**
	  ○ **Identify challenges**
	  ○ **How to overcome these?**
	• **Goal 3: Collect feedback on training opportunities**
	  ○ **Task 1.3. Identify how is feedback on training gathered and acted upon**
	  ○ **Identify barriers**
	  ○ **Identify challenges**
	  ○ **How to overcome these?**

ICT Components	• **Simulated croft environment:** gamification helps to entertain and engage visitors to the digital platform • **360-degree footage**: Bespoke visual footage helps to engage participants and create interactive context • **Embedded resources:** give details of the contextual environment, lasting resources, why the training is important, details of use • **Embedded icons:** provide URL link to training opportunities, date/time/place/contact details, how to register

Elements identification process and observations

Following a showcase session with LL participants of a DigiTool the use case elements were identified. Discrete conversations with stakeholders interested in training, for both crofters and smallholders based in remote and often island situations, were used to further identify elements crucial to the use case. These were further refined during subsequent internal Hutton discussions.

Currently many communication channels are used to contact crofters to promote training opportunities including: social media; websites; newsletters; community hall notice boards; assessors (crofting specific local point of contact).

It was noted that stakeholders had a clear opinion as to who was able to access digital information by using computers:

"Age is not a clear indicator of who can use computer technology, many 40-50 year olds did not engage online whereas several 80+ crofters were able to participate actively online completing surveys and forms where necessary."

Stakeholders identified remote crofters and small holders often struggled to identify source training sessions they could access. Often several sites were needed to be accessed to gather potential training opportunities. Some training might only be open to members of organisations. This could tend to exclude non-members, in some cases the smallholders due to the lack of membership to the Crofting organisations. Gathering information onto one digital platform, open to all, could be used to signpost people to potential training opportunities, widening access to all.

Task Descriptions

Task 1.1

- **Task Name:** Identify current ways to engage crofters with training opportunities
- **How is this performed right now?**
    - Currently people check a range of websites; social media; newsletters; community boards for information
    - Many suppliers of courses all advertise/promote courses in different ways
- **Which are the weaknesses/issues of the current approach?** Please list the weaknesses of the current approach, which lead to the need to introduce an ICT system / digital tool
    - No one place to look for training
    - Training opportunities missed
    - Low turn out
    - Time consuming
- **How can this be supported by an ICT system / digital tool**
    - The crofters will be able to access the DigiCroft for information on training courses
    - The course providers can use the DigiCroft as a signpost to direct people to their websites, this helps reduce the number of places updates need to be posted
- **Actors Involved:** list the actors that are involved in this task

  - Crofters/smallholders
  - Course providers

- **ICT components:** list the ICT components involved in this task
  - DigiCroft: simulated environment
  - 360-degree footage
  - Embedded links

Task 1.2

- **Task Name:** Identify how to best guide crofters to potential training opportunities
- **How is this performed right now?** Please describe how the task is performed right now
  - Course providers disseminate information, by word of mouth, newsletters, member only websites, organisation websites, social media
  - Interested people sign up to course
- **Which are the weaknesses/issues of the current approach?** Please list the weaknesses of the current approach, which lead to the need to introduce an ICT system / digital tool
  - Time consuming
  - Missed opportunities
  - People excluded
  - Inaccurate information
- **How can this be supported by an ICT system / digital tool?**
  - People engage with the platform
  - Find out about potential skills
  - Get directed to training opportunities
- **Actors Involved:** list the actors that are involved in this task
  - Crofters
  - Smallholders
  - People interested in new skills
- **ICT components:** list the ICT components involved in this task
  - Simulated environment
  - Embedded lasting resources

- Links to training providers

Task 1.3

- **Task Name:** Identify how is feedback on training gathered and acted upon
- **How is this performed right now?** Please describe how the task is performed right now
  - Little gathered
- **Which are the weaknesses/issues of the current approach?** Please list the weaknesses of the current approach, which lead to the need to introduce an ICT system / digital tool
  - No feedback means the system is difficult to improve
- **How can this be supported by an ICT system / digital tool?**
  - Visitors to the platform can click on an embedded survey link to provide feedback
- **Actors Involved:** list the actors that are involved in this task
  - Crofters/smallholders
  - Visitors to the digital platform
- **ICT components:** list the ICT components involved in this task
  - Simulated environment
  - 360-degree footage
  - Embedded survey link

Task description process and observations

Task descriptors were developed by the internal Hutton team following in-depth discussion with various actors. as previously described.

Impacts, Drivers and Barriers

Impacts

Goal	Impact
Goal 1: Engage crofters with training	**Economical:** • Increased skills help diversification, streamlining production processes therefore saving money

	Social: ● Potential for crofters to expand networks, and social skills **Governance:** ● Training could allow crofters to engage with policy and regulations **Environmental:** ● Improve environmental practices
Goal 2: Point crofters to potential training opportunities	**Economical:** ● Time will be saved visiting only one website, improving efficiency **Social:** ● Crofters can network more efficiently **Governance:** ● Training will allow better policy and regulation awareness
Goal 3: Collect feedback on training opportunities	**Economical:** ● Information on training opportunities can be targeted improving uptake and better use of funding **Governance:** ● Funding can be targeted

Drivers

Goal	Driver
Goal 1: Engage crofters with training	**Economical:** ● Required to improve business skills **Social:** ● Improves networks and networking skills **Governance:** ● Help crofters understand policy and legislation

	Environmental: ● Improve environmental impact
Goal 2: Point crofters to potential training opportunities	**Economical:** ● Better economic use of training courses ● Improved uptake of places on training courses, improved efficiency and resilience of course **Social** ● Empowers people to engage
Goal 3: Collect feedback on training opportunities	**Economical:** ● Better use of resources, improved dissemination of information **Governance:** ● Improved use of funding

Barriers

Goal	Impact
Goal 1: Engage crofters with training	**Economical:** ● Lack of broadband connectivity, digital skills or money to buy laptops would restrict ability to engage with the DigiTools **Environmental:** ● Poor broadband connectivity due to remote location
Goal 2: Point crofters to potential training opportunities	As above
Goal 3: Collect feedback on training opportunities	As above

Identification process and observations

Brainstorm session with LL Hutton team delivered many positives and allowed specific observations to be identified.

Photos and Additional Material

Screenshots on simulated DigiTool environment under development

General Feedback and Conclusion

The expert actors found the discussions useful, the opportunities to reflect allowed all actors the opportunities to share experiences and discuss current activities. They had the chance to exchange views on how to move forward and what would be best for the communities that could be reached.

Currently many systems are used to inform potential audiences of training opportunities that are focused on upskilling the crofting and smallholder communities in remote rural locations. Not all these are on-line methods, many rely on members of the communities accessing local locations that might involve a chance viewing of a paper poster or leaflet. Travelling to central locations for the chance viewing can be random, time consuming and often difficult or impossible during severe weather conditions. Although on-line options are more reliable for access, some sites are member only and can exclude some community members. By providing a digital solution that is accessible by all crofters and smallholders will find a single site that is informative and helps signpost them to potential sites, reaching search time causing less frustration and helping people to apply for training opportunities. Current options also rely on people already knowing what they are looking for, for on-line solutions

search engines require the correct keywords to be used to search for specialised courses. In reality people often need inspiration, additional resources can inform visitors to the site of opportunities and benefits that training can bring. Gamification of the platform would help entertain visitors whilst offering opportunities to engage and access resources providing additional knowledge.

In addition the expert actors that engaged with the process reflected on the positives of developing a platform that could be easily updated by the various organisations that would not require constant additional resources in terms of both time and financial commitments. The digital signposting platform concept will contain embedded links to various organisation websites. The organisations will be able to update their websites without requiring access to the digital platform and without the requirement to make additional data inputs. In this way the digital platform will not require constant maintenance and data moderation.

One negative that was highlighted was that initial good publicity would be required to ensure a high level of engagement with the digital platform. Visitors could be made aware of the DigiCroft by using a wide-reaching launch event, possibly using an existing event to give maximum exposure. Consideration will be given to ensure the DigiCroft launch has both a high-level image, with good accessibility, whilst appealing to a wide audience to achieve maximum impact.

The general consensus of the experts, that were able to engage with the process, was that this was a niche digital tool that would fill an existing gap in technology that should be developed to help the remote rural communities promote training opportunities, increasing access for all.

AT use case

The name of the Living Lab is: “Round Wood Traceability in Austria”.

Brief summary of LL

Austria has a strict, long-existing forest law guaranteeing sustainability: the word sustainability originates from the domain forestry itself and is defined as guaranteeing more growth than felling. Nevertheless, to fulfil the yearly demand of roundwood, timber is acquired from the European and international market. This poses the threat of placing illegal deforested products on the European market, which is what the EUTR is tackling; illegality is not only defined as cutting down endangered tree species, but also breaching national forestry laws. The focal question dealt within this living lab is phrased the following way: “*How can digitalisation support and enforce the adoption of the European Timber Regulation (EUTR) concerning imported round wood in Austria?”*

The effects of digitalisation impacts the availability of information and the way information is exchanged and communicated. Digitalisation allows information to travel faster; generally speaking, transparency counters clandestine activities. Contrarily, an abundance of information needs efficient data filtering, storage and distribution. Forestry is a domain which is experiencing a high degree of technological advancement, only, the institutional circumstances are not there yet, for technological innovation to gain importance when tackling illegal logging.

LL participants

The two entities involved in this activity are the workshop coordinator and a start-up. The start-up, BeetleForTech, offers a solution for seamless roundwood traceability. They develop a global timber tracking network to secure provenance of resources, a solution for simpler compliance and advocacy of sustainable forestry worldwide. Their work is closely linked to the focal question of this activity.

Timing of Use Case activities

An initial meeting including the use case participants was held online. Based on the provided use case guidelines, the steps needed to carry out use case workshop were discussed. The first meeting also included the definition of a use case statement, an initial set of actors and tasks and ICT components. In a second online meeting, the use case elements were finalized and the description of tasks was started. The document including all remaining elements was finalized collaboratively in the third online meeting.

Date / Type	Activity	Duration	Participants and Background	Output

05/05/2022 (Remote)	Interview	3 hours	Co-founder of BeetleForTech (background: forestry)	Definition of use case statement; initiation of use case elements
30/05/2022 (Remote)	Interview	1 hour	Co-founder of BeetleForTech (background: forestry)	Finalization of use case elements; initiation of tasks description
31/05/2022 (Remote)	Interview	2 hours	Co-founder of BeetleForTech (background: forestry)	Finalization of tasks description & Impacts, drivers and barriers

Use Case Summary

The use case discussed in this document reflects the work of the Austrian start-up BeetleForTech. The start-up is working on providing a solution for the seamless traceability of roundwood. The solution developed in house is based on diverse technologies and is globally applicable. The process of guaranteeing traceability includes immediate tagging of a freshly logged tree on-site, a process which automatically registers the initial geolocation of the logged tree. Arriving at the processing facility, the single-tree is registered into the central, internal management system; additional information, such as the transportation route is provided by the operators and traders, selling wood. The overarching goal of BeetleForTech is the strengthening of forest biodiversity, through providing global traceability. Being able to trace a tree and further processed wood products back to the origin, enables to verify legality. Illegality is not only defined as cutting down endangered tree species, but also breaching national forestry laws. Both breaches eventually contribute to the loss of biodiversity. To verify that a tree has been logged lawfully and orderly, the verification system of BeetleForTech includes verification methods based on satellite data. The technology applied in the description of this use case includes a mobile tagging device, a scanning device at the wood processing facility, GNSS technology for the registration of the geolocation of a tree, satellite data for verification and a cloud infrastructure for a centralized storage of relevant information, which allows to query for data. Transmission of data is based on mobile technologies. The steps described in this use case include Tagging, Registration, Combination and Verification.

Use case statement

The goal of the system is to provide global single tree roundwood traceability involving loggers, traders and processors to strengthen forest ecosystem resilience. The system relies on a mobile tagging device

and on data collected from remote sensing systems, i.e., satellites for global positioning (GNSS) and optical satellites for verification.

Use case statement development and observations

The use case guideline provided an ideal starting point for the definition of the use case statement. An initial definition was prepared by the use case organizer. It was discussed in the first online meeting with the second use case participant and rephrased accordingly. It is phrased to include one main goal and an additional soft-goal. The main goal, to provide global roundwood traceability, is the core of the business of Beetle for Tech, whilst strengthening the forest ecosystem resilience is the overarching goal.

Use Case Elements

The following table includes the list of elements relevant for the presented use case.

Element	List
Actors	• **European Commission**: The European Commission (EC) is the high-level instance interested in preserving the forest ecosystem • **User**: A user, i.e., a private person or entity interested in tracing the origin of wood or wood products, e.g., ○ National forest agencies: National forest agencies are the national legal entities executing the agenda of the EC • **Loggers**: A private person or entity responsible for cutting down trees, in order to trade or sell the timber • **Operators & Traders**: A mostly internationally active agent or entity buying and reselling timber and timber products • **Processors**: An entity responsible to processing logs into various further wood-based products
Goals	• **Provision of global roundwood traceability**: The goal of the system is to provide global traceability of roundwood involving loggers, traders and processors to strengthen forest ecosystem resilience
Tasks	• **Goal 1: Provision of global roundwood traceability** ○ Task 1.1. Tagging: This task consists of tagging single trees on-site after felling, using a handheld tagging device. The task is carried out by the loggers and allows to identify single trunks of roundwood. With tagging, a first registration of the tree's location is sent to the GNSS system

	○ Task 1.2. Registration: At the wood processing facility, after the arrival of the individual logged trees, the previously attached tag is automatically registered using a digital scanning technology. This way, the single tree is registered into the internal cloud infrastructure ○ Task 1.3. Combination: Additional information, e.g., the transport route, is linked to each registered tree automatically within the system ○ Task 1.4. Verification: To verify legality and the origin of a single piece of roundwood, a query of the database of the cloud infrastructure is performed
ICT Components	● GNSS: GNSS is the Global Navigation Satellite System which enables global positioning of objects. It is used to collect the positioning data of trees, from the location of the felling along the route of transport to the processing facility ● Satellite data: this component is used to verify tree extraction in a specific location in a given canopy. The purpose is to visually verify the logging of single trees ● Tagging device: this component is used to tag a single with a unique identification, to allow the identification of each roundwood ● Scanning device: this component is a device capable of automatically scanning trees at processing facilities at the handover/arrival ● Cloud infrastructure: this component is a digital environment where digital information is stored, combined and exploited ● Mobile broadband: this component is a digital technology for the transmission of data making use of mobile frequency

Elements identification process and observations

A first list of elements was identified during the first online meeting amongst the participants. The elements where updated and/or edited during the following online meetings.

Task Descriptions

The following chapter describes the four tasks previously mentioned. The tasks are Tagging, Registration, Combination and Verification and are the necessary steps involved to provide global roundwood traceability.

Tagging

- **Tagging:** This task consists of tagging single trees on-site after felling, using a handheld tagging device. The task is carried out by the loggers and allows to identify single trunks of roundwood. With tagging, a first registration of the tree's location is sent to the GNSS system. The task contributes to the goal provision of global roundwood traceability
- **How is this performed right now?**
    - Currently, this task is not performed routinely
    - In case a tree trunk is tagged, it usually happens at the first intermediate transportation location, not at the location of the felling
    - Currently, the tagging predominantly has the purpose of internally organizing fellings, not for the purpose of traceability
- **Which are the weaknesses/issues of the current approach?**
    - Conventional tagging is seldomly performed at the location of the felling
    - Traditional tagging methods do rarely include the transmission of the geolocation
    - Current tagging methods do not focus on the purpose of traceability, but are rather used for internal organizational purposes
    - Current tagging systems tend not to be user-friendly
- **How can this be supported by an ICT system / digital tool?**
    - After logging a tree, the logger uses the handheld tagging device to provide the tree with a unique identification, to register the location of the felling (GNSS), be able to distinguish it from other trees and trace the transportation route to the processing facility
    - The handheld device automatically transmits the identification and location information to the cloud infrastructure using mobile broadband technology
    - Once tagged, the tree is ready for transport to the processing facility
- **Actors Involved:** list the actors that are involved in this task
    - Loggers
- **ICT components:** list the ICT components involved in this task
    - Handheld tagging device
    - GNSS data
    - Cloud infrastructure
    - Mobile broadband

Registration

- **Registration:** At the wood processing facility, after the arrival of the individual logged trees, the previously attached tag is automatically registered using a digital scanning technology. This way, the single tree is registered into the internal cloud infrastructure. The task contributes to the goal provision of global roundwood traceability
- **How is this performed right now?**
    - Currently, this task is not performed routinely
- **Which are the weaknesses/issues of the current approach?**
    - No combination of location aware easy tagging at the felling site and automatic registration at the processing facility currently in operational use
- **How can this be supported by an ICT system / digital tool?**
    - The operator or trader hands over the trees at the processing facility for resale or further processing
    - At the processing facility, the new location of the previously tagged individual single trees is automatically transmitted to the cloud infrastructure using mobile broadband technology through the scanning device
    - Within the cloud infrastructure, the location information is updated automatically, to reflect the transportation route of an individual tree
- **Actors Involved:** list the actors that are involved in this task
    - Operators and Traders
    - Processors
- **ICT components:** list the ICT components involved in this task
    - Scanning device
    - Mobile broadband
    - Cloud infrastructure

Combination

- **Combination:** Additional information, e.g., the transport route, is linked to each registered tree automatically within the system. The task contributes to the goal provision of global roundwood traceability
- **How is this performed right now?**

- Taking the European timber market as an example, the European Union legally requires operators and traders of wood to run and maintain a due diligence system (DDS)
- The DDS requires operators and traders to keep record of documents, including felling permit, cubic metres, tree species, etc.
- The documents are randomly checked by the responsible national forest agencies

- **Which are the weaknesses/issues of the current approach?**
  - The current procedure is heavily based on paper and online documents, which are prone to forgery
  - The current approach is time consuming
- **How can this be supported by an ICT system / digital tool?**
  - The operators and traders upload all relevant documents to the cloud infrastructure, to submit the trees' location information and confirm the legality of the felling
  - Within the cloud infrastructure, all available information is linked to the dedicated trees which were registered within the system in the previous tasks
  - In addition, the cloud infrastructure automatically obtains satellite data over the location of the felling of the single tree, for future verification
- **Actors Involved:** list the actors that are involved in this task
  - Operators and Traders
- **ICT components:** list the ICT components involved in this task
  - Cloud infrastructure
  - Mobile broadband
  - Satellite data

Verification

- **Verification:** To verify the transportation route, the legality and the origin of a single tree, a query of the database on the cloud infrastructure is performed. The task contributes to the goal provision of global roundwood traceability
- **How is this performed right now?**
  - The documents collected in the previous task by the operators and traders are randomly checked by the national forest agencies for completeness, consistency and legality
  - The task performed in the current approach consists mostly of desk work, document checks, phone calls and internet research and verification

  - Due to time and constraints of manpower, only few, more thorough on-site checks are performed

- **Which are the weaknesses/issues of the current approach?**
  - The current approach is time consuming
  - The current approach makes it difficult to verify legality
  - The current approach does include digital technologies for verification purposes only to a minimal extent; no technologies e.g., satellite data for verification are used
  - With regard to the example of the European timber market, there is no central cloud infrastructure containing all relevant information
- **How can this be supported by an ICT system / digital tool?**
  - The user logs into the cloud infrastructure to check the origin and the transportation route and investigate legality of the wood or wood product
  - The user performs a database on the cloud infrastructure query to check the origin and the transportation route and investigate legality of the wood or wood product
  - The cloud infrastructure outputs all relevant information, including GNSS data and satellite data, to inspect and verify time and location of the felling using independent observational technologies
- **Actors Involved:** list the actors that are involved in this task
  - User
  - National forest agency
- **ICT components:** list the ICT components involved in this task
  - Cloud infrastructure
  - GNSS data
  - Optical satellite data

Task description process and observations

Starting from the second online meeting, the tasks were elaborated and formulated in detail. The tasks were discussed openly amongst the participants. A final review was performed during the last online meeting.

Impacts, Drivers and Barriers

Impacts

The following table gives an overview of the economic, social, governmental and environmental impacts concerning the goal to provide global roundwood traceability.

Tasks	Goal	Impact
Task 1.1 Tagging Task 1.2 Registration Task 1.3 Combination Task 1.4 Verification	**Goal 1** Provision of global roundwood traceability	**Economical:** • **Illegal logging** Traceability of wood and wood products counters illegal logging activities • **Certificates** New certification can be applied to wood and wood products, marketing the legality and sustainability of the products **Social:** • **Sustainability** Through global roundwood traceability, a decrease of loss of forest biodiversity can be achieved, resulting in a more sustainable future for society • **Inequality** The availability of a global traceability system can contribute to social equality in countering organized crime **Governance:** • **Unity** The provision of a globally applicable solution for roundwood traceability contributes to the unity of governmental efforts **Environmental:** • **Biodiversity** Through more control of illegal logging, the loss of forest biodiversity can be reduced

Drivers

The following table gives an overview of the economic, social, governmental and environmental drivers concerning the goal to provide global roundwood traceability.

Tasks	Goal	Driver
Task 1.1 Tagging Task 1.2 Registration Task 1.3 Combination Task 1.4 Verification	**Goal 1** Provision of global roundwood traceability	**Economical:** • **Certificates** New certificates advertising sustainable wood and wood products for marketing . • **Illegal logging** Counter the increase of illegal logging activities **Social:** • **Awareness** Increasing awareness of the population concerning the positive effects of forests • **Consumption** Increasing consumption of sustainable wood and wood products **Governance:** • **Political Parties** Increase of political green parties in government **Environmental:** • **Biodiversity** Increasing global loss of forest and plant biodiversity

Barriers

The following table gives an overview of the economic, social, governmental and environmental barriers concerning the goal to provide global roundwood traceability.

Tasks	Goal	Impact
Task 1.1 Tagging Task 1.2 Registration Task 1.3 Combination	**Goal 1** Provision of global roundwood traceability	**Economical:** • **Competition** Competitors see a potential threat to their business and try to stop or minimize innovation

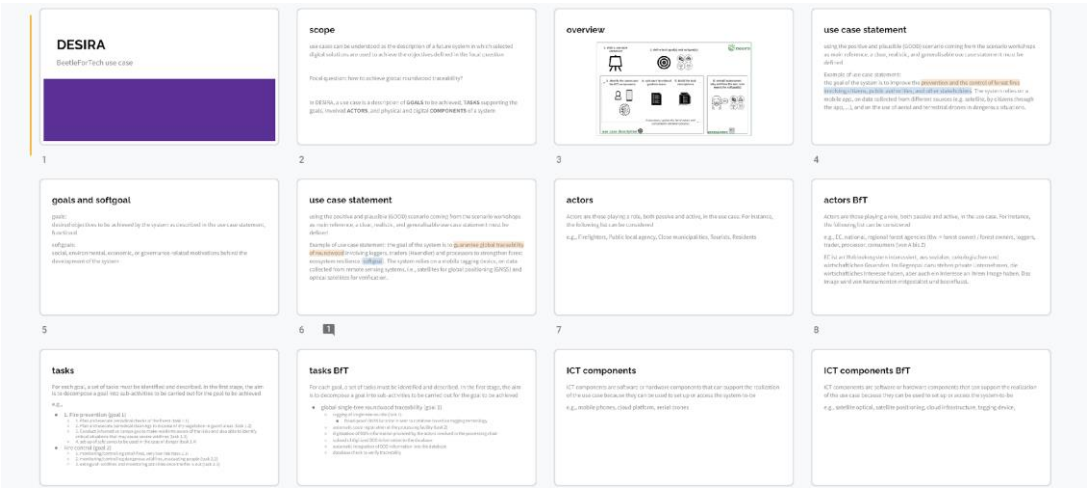
Task 1.4 Verification		• **Costs** High costs of system implementation and maintenance **Social:** • **Awareness** Lack of awareness of the need for global sustainability and sustainable forest management **Governance:** • **Bureaucracy** Lack of funding, lack of support, lack of innovation for technological solutions and development **Environmental:** • **n/a**

Identification process and observations

The impacts, drivers and barriers of reaching the goal of global roundwood traceability were found and discussed in an open manner during the third online meeting. At the end of the meeting, all elements were reviewed.

Photos and Additional Material

The figure below displays a screenshot of some slides which were used to introduce and discuss the use case. The slides were furthermore used as an interactive tool to collaboratively work on thoughts and write down ideas.



General Feedback and Conclusion

From the position of both parties involved in the generation and implementation of the presented use case, the activities proved to be useful. For BeetleForTech, it was helpful to draft and phrase the steps and tasks in a clear and concise manner. For SISTEMA, to understand the high-level technical steps necessary to provide wood traceability were insightful.