Co-design of Technological Solutions for Agriculture and Rural Areas: Methodology and Cases for Responsible Innovation

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Outline

The H2020 DESIRA project

Use cases in DESIRA: methodology and purpose

An example and results from the Living Labs

Conclusions and feedback

the EU H2020 DESIRA project

Digitisation: Economic and Social Impacts in Rural Areas (DESIRA) https://desira2020.eu

The project aims ***to improve the capacity of society and political bodies to respond to the challenges that digitalisation generates in agriculture, forestry and rural areas.***

fill the socio-economic knowledge gaps on digitalisation in agriculture, forestry and rural areas

assess the past and current socio-economic impact of digitalisation in relation to SDGs

improve the capacity of communities to reflect on future risks and opportunities of digitalisation

improve the capacity of rural communities to reap the opportunities offered by digitisation and to improve resilience to related associated risks

promote online and offline interaction and learning among a wide range of stakeholders

increase the uptake of societal concerns in ICT-related policy and innovation, and to align digitalisation scenarios with societal needs and expectations

DESIRA: 21 Living Labs

Living Labs are **networks** of rural businesses, public authorities, citizen groups, digital technology operators, farmers and researchers who **co-develop** ideas, scenarios, and socio-technical solutions related to digitalisation in rural areas.

Living Labs: the process within

broad topic

past and present

future

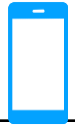
co-design

focal question

refined focal question

desired trajectory

digital tools for the future

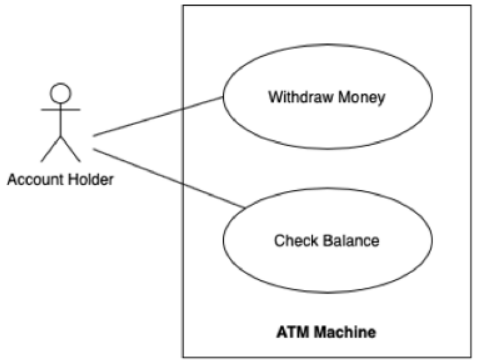
Living Lab	focal question	scenario question
Tuscany, IT (land management) 	How can better communication among citizens, stakeholders and public administration make ordinary land management in marginal rural areas more effective?	How will the ordinary land management in mountain areas of the Reclamation 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) 	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) 	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) 	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) 	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?

WHAT IS A USE CASE: a general definition

In software engineering, a use case is a list of ACTIONS performed by an ACTOR to achieve a certain GOAL through interaction with a SYSTEM.

example: use case for 'money withdrawal from an ATM'

- GOAL: money withdrawal
- ACTOR: user
- ACTIONS:
  - The user inserts the card
  - The user inserts its PIN
  - The user selects the desired amount of money
  - [...]



Use Case Diagram

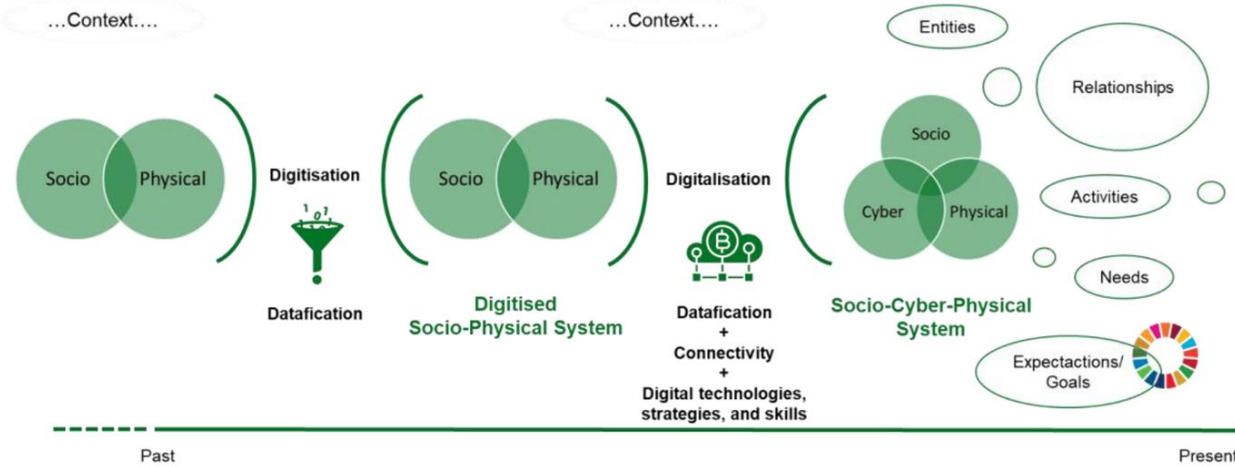
- Use Case Name: Withdraw Money
- User: Account Holder
- Steps:
  - The user inserts the card
  - The user inserts its PIN
  - The user selects the desired amount of money
  - [...]

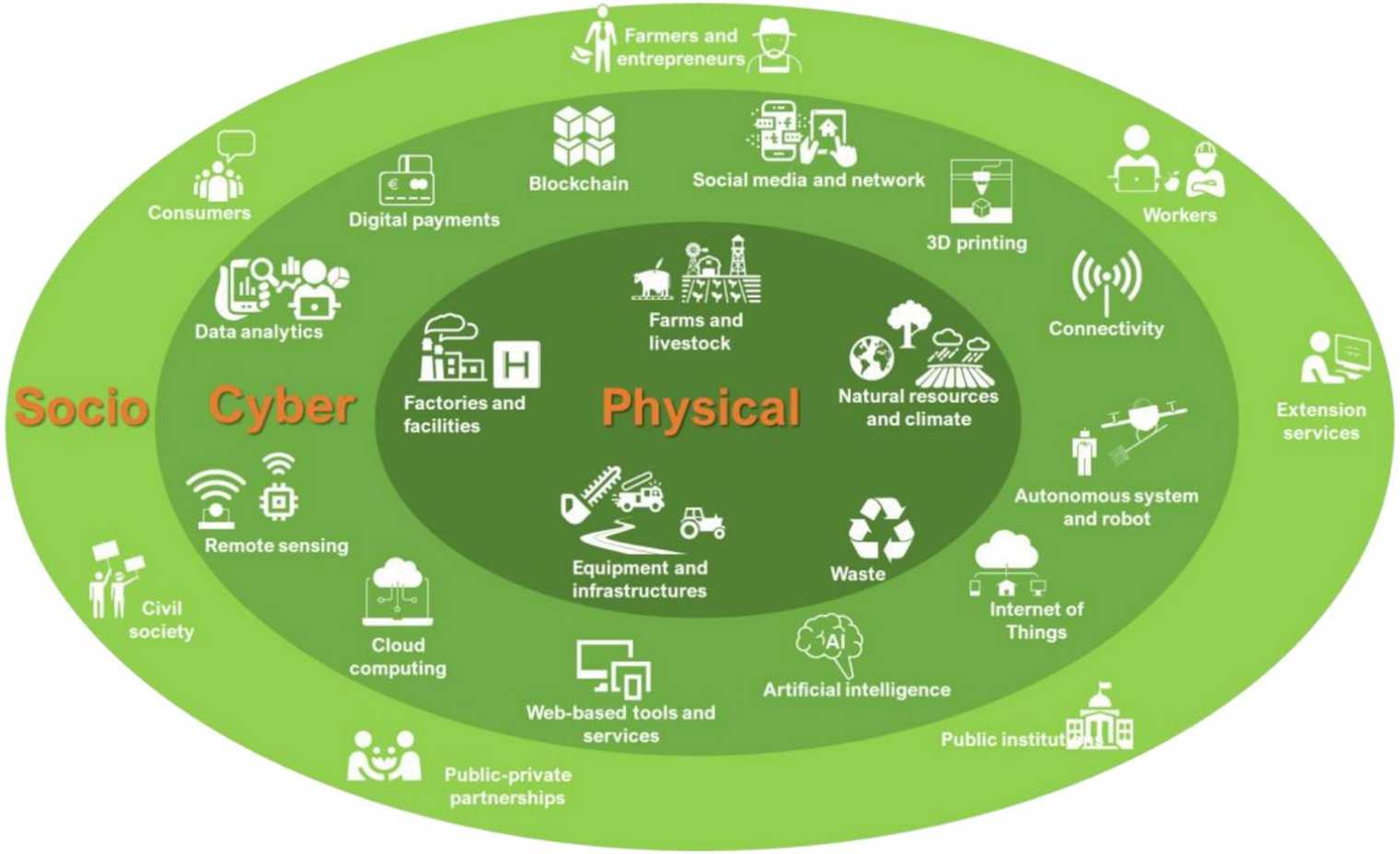
Use Case Specification (for Withdraw Money)

USE CASES IN THE DESIRA PROJECT: concept adaptation

In DESIRA, we emphasize the **digital** as one of the parts of a **socio-cyber-physical system** (the LL), thus the methodology to carry out use case workshops covers also *drivers*, *barriers*, and *impacts*.

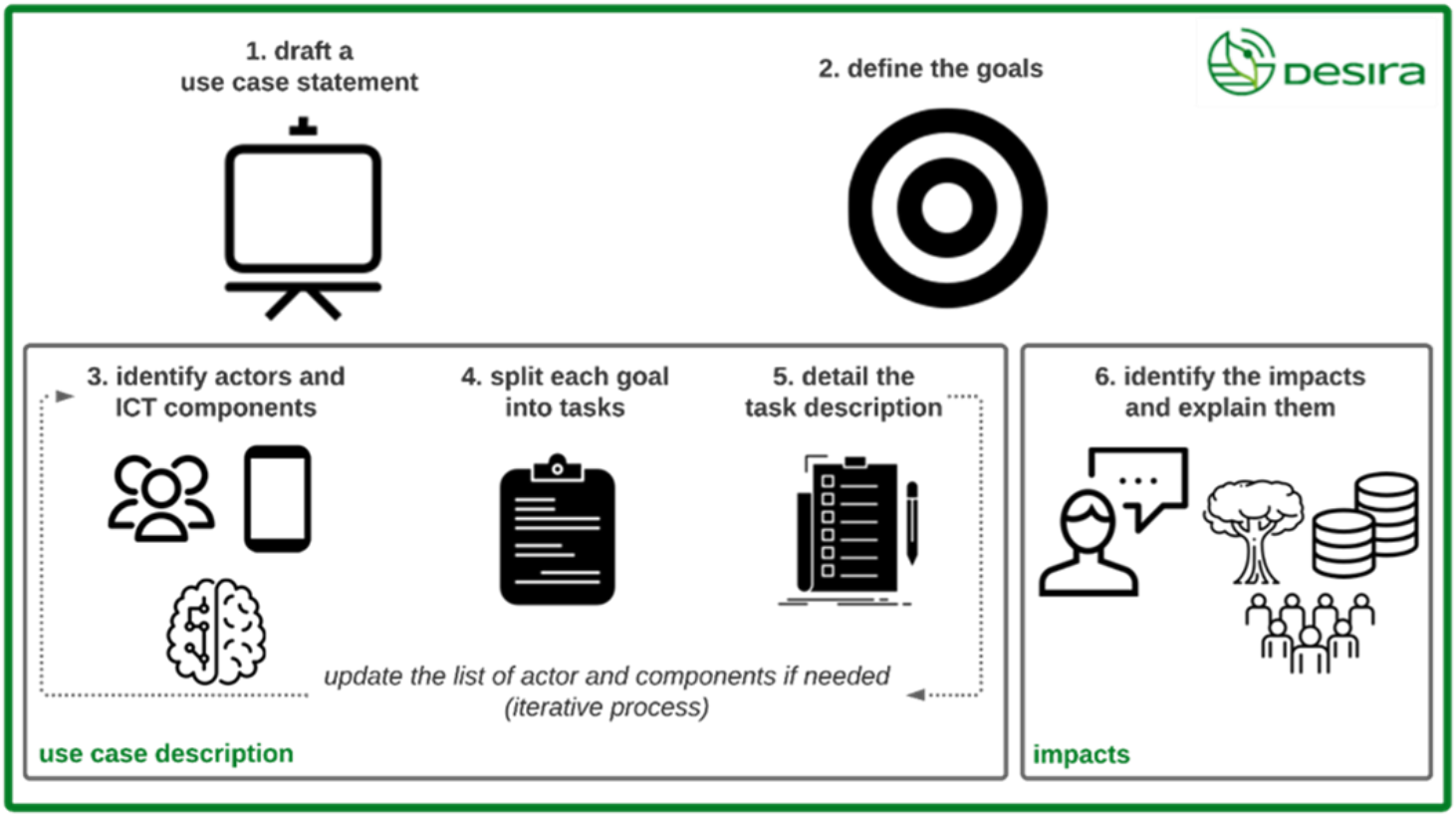
LLs developed high-level use cases. This is what one would expect after an initial iteration among analysts and users, enriched by a **socio-economic perspective**.



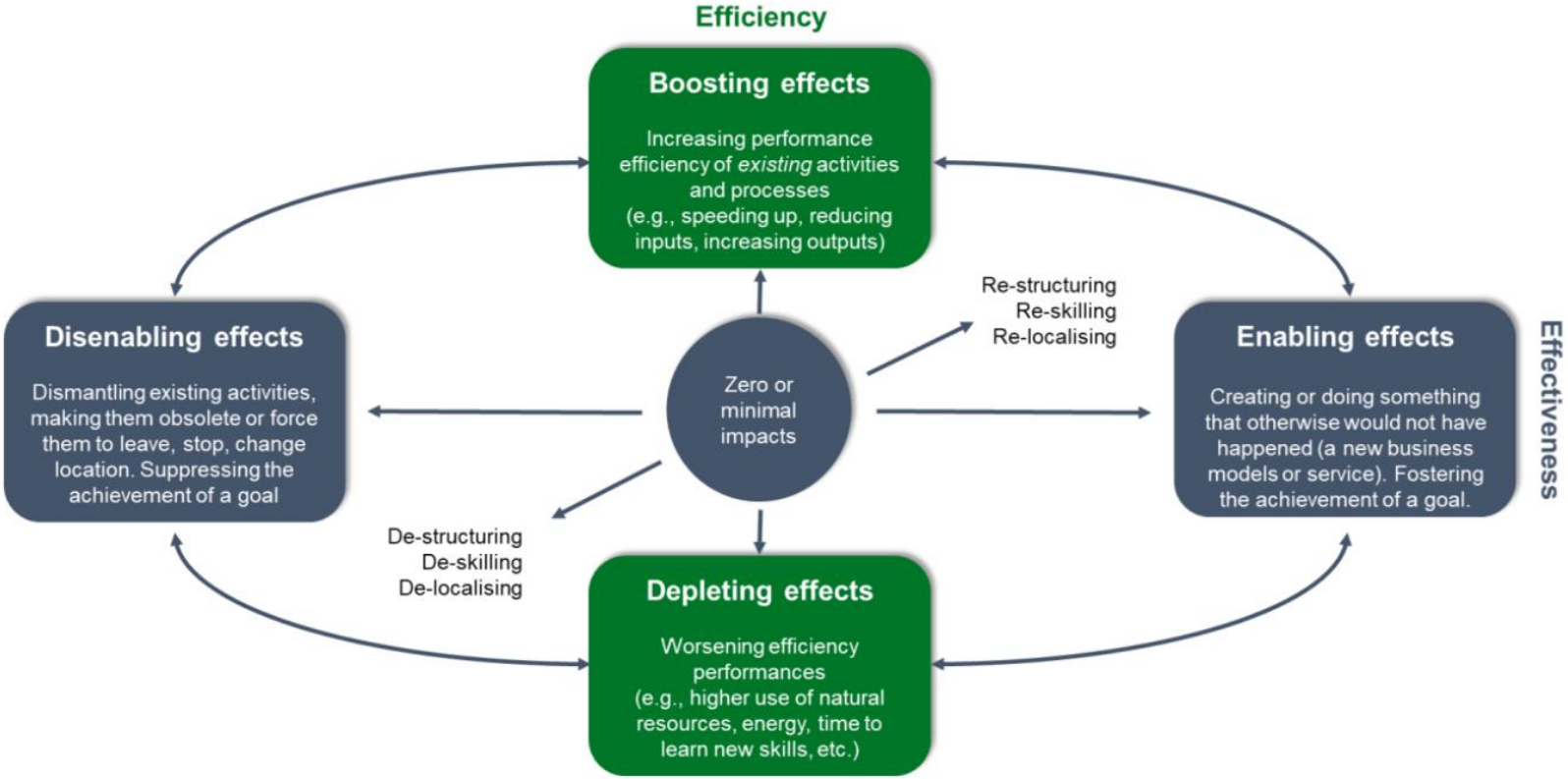


Rijswijk, K., Klerkx, L., Bacco, M., Bartolini, F., Bulten, E., Debruyne, L., ... & Brunori, G. (2021). *Digital transformation of agriculture and rural areas: A socio-cyber-physical system framework to support responsibilisation*. Journal of Rural Studies, 85, 79-90.
Metta, M., Ciliberti, S., Obi, C., Bartolini, F., Klerkx, L., & Brunori, G. (2022). *An integrated socio-cyber-physical system framework to assess responsible digitalisation in agriculture: A first application with Living Labs in Europe*. Agricultural Systems, 203, 103533.

INFOGRAPHIC: how to build a use case



Destructuring impacts



STEP 1: use case statement (focus group)

Define a clear, realistic, and generalisable USE CASE STATEMENT

Clear means that it is well defined and not ambiguous (at least for the participants)
Realistic means that the objective is feasible with known/existing tech
Generalisable means that the objective should be achievable in general settings as much as possible so that the output can be used in other contexts

STEP 1: use case statement from the focal question - an example -

Focal question: how to reduce the risk of forest fires?

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

STEP 1: the goals in the use case statement

Once the participants agree on a brief and clear statement, the main **goal(s)** in it must be outlined. If the use case statement is written in an effective way, identifying goals should be rather easy.

From the previous example, the following goals can be derived from it:

1. *prevention of forest fires;*
2. *control forest fires;*
3. *involve community.*

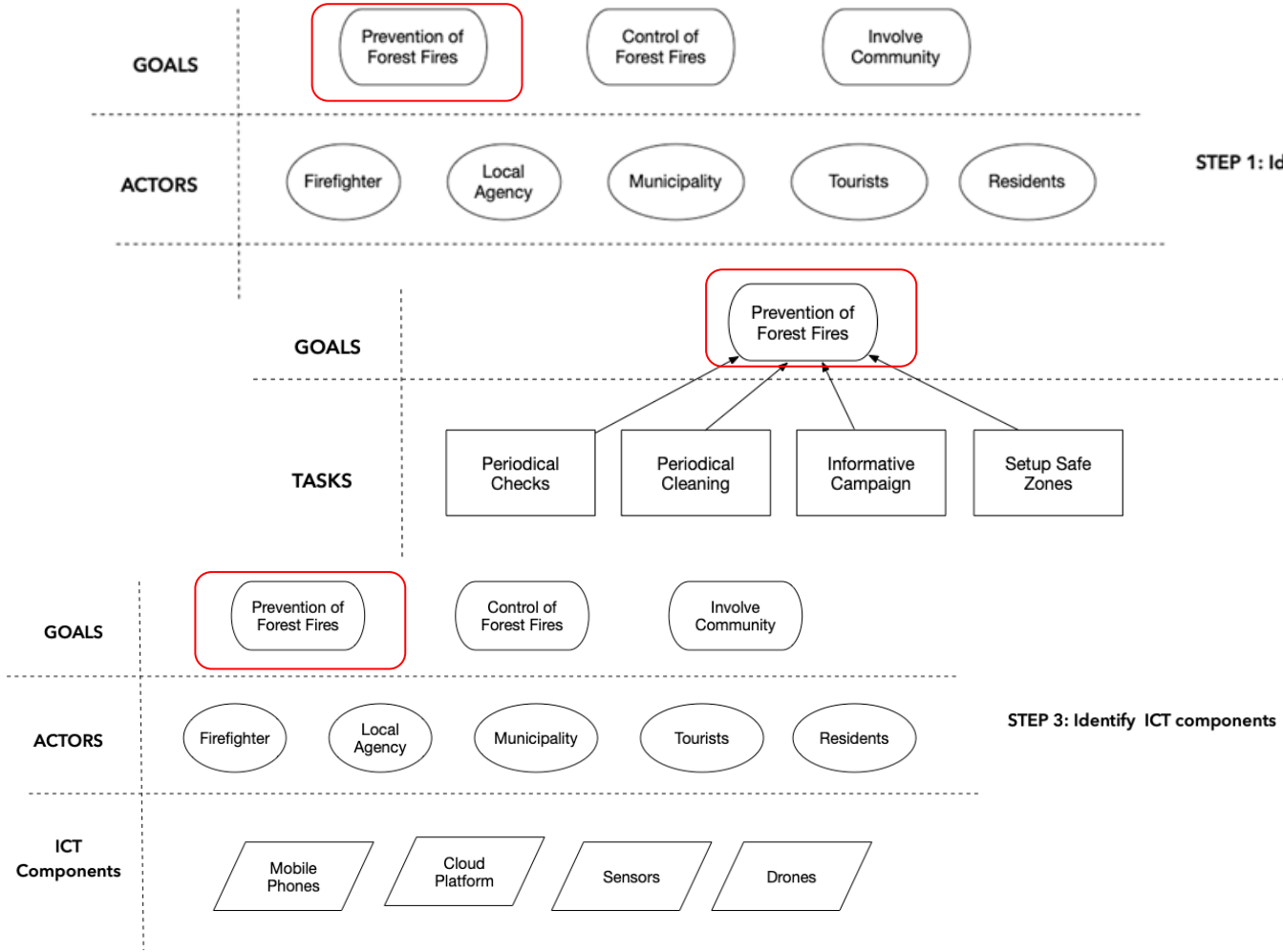
Goals are unlikely to contain technological elements in them (e.g., use of data, mobile app, drones), instead focusing on other dimensions or immediately defining **plausible actions**. A rule of thumb to make sure that *i)* goals are understandable by everyone and *ii)* they are defined as needed.

The statement should also mention some entities, such as actors (citizens, public authorities etc), tools (a mobile application), data / data sources of interest (satellite), and so on. The statement can already contain a few details like these to clarify the direction of investigation; yet, those are not goals, but rather elements to be used to achieve the goals.

USE CASE SPECIFICATION (in focus groups)

Use case specification

- **actors**: involved actors (e.g., *firefighters, citizen, municipality, local agency*);
- **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 are 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, planning interventions*);
- **ICT components**: digital 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 describe a single action, but can involve multiple actors.


GOALS
Prevention of Forest Fires
Control of Forest Fires
Involve Community
ACTORS
Firefighter
Local Agency
Municipality
Tourists
Residents
STEP 1: Identify Goals and Actors
GOALS
Prevention of Forest Fires
TASKS
Periodical Checks
Periodical Cleaning
Informative Campaign
Setup Safe Zones
STEP 2: Identify Tasks for each Goal
GOALS
Prevention of Forest Fires
Control of Forest Fires
Involve Community
ACTORS
Firefighter
Local Agency
Municipality
Tourists
Residents
STEP 3: Identify ICT components
ICT Components
Mobile Phones
Cloud Platform
Sensors
Drones

DRIVERS, BARRIERS, IMPACTS (in a plenary workshop)

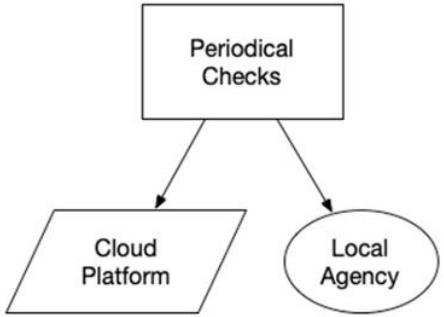
impacts: potential desired and undesired short and long-term consequences related to the development of the system. The goals of the system, if achieved, may have certain impacts. Impacts can be both positive or negative.
e*conomic: increased tourism in the area (positive).*
social: exclusion of subjects who cannot use technology (negative).

drivers: any factor (phenomenon, event, or individual/collective need) that could facilitate the achievement of a certain goal.
e*conomic: increased funding from Europe.*
governance: need to increase control of the area.

barriers: any factor (phenomenon, event, or individual/collective opposition) that could hinder the achievement of a certain goal.
governance: complexity of regulations.
social: opposition to technology; aging population.

4 dimensions of interest: social, environmental, economic, and governance

Rolandi, S., Brunori, G., Bacco, M., & Scotti, I. (2021). *The digitalization of agriculture and rural areas: Towards a taxonomy of the impacts. Sustainability, 13*(9), 5172.
Ferrari, A., Bacco, M., Gaber, K., Jedlitschka, A., Hess, S., Kaipainen, J., ... & Brunori, G. (2022). *Drivers, barriers and impacts of digitalisation in rural areas from the viewpoint of experts*. Information and Software Technology, 145, 106816.



- How is it performed right now?
- What are the weaknesses?
- How can it be supported by a digital tool (ICT Components)?
- Who are the involved Actors?

STEP 4: Describe the Tasks (can lead to more Actors, and ICT components in the initial list)

STEP 5: Impacts, Drivers, Barriers

Tasks	Goals	IMPACT
periodical checks periodical cleaning informative campaign setup safe zones	Prevention of Forest Fires	**Economical:** less resources for controlling wildfires **Social:** more sense of safety **Governance:** less emergency **Environmental:** less wildfires, more vegetation
....	Control of Forest Fires	**Economical: ...** **Social: ...** **Governance: ...** **Environmental: ...**
....	Involve Community	**Economical: ...** **Social: ...** **Governance: ...** **Environmental: ...**

Living Lab	use case statement
Tuscany, IT (land management)	**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)	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 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 producers in the market.
Rhineland-Palatinate, DE (communication and gender)	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)	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)	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.

Summing up

DESIRA has proposed a novel methodology for use cases that goes beyond the traditional one.

The *socio-cyber-physical system* conceptualisation 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.

Your feedback, your role

The use cases may provide a valuable starting point for software companies willing to design and develop digital tools - not only according to users' needs and desires - tailored to different rural contexts and users' needs.

- As experts, how does this methodology fit with your typical way of designing and developing IoT systems?
- To what extent do you consider, and model, the environment in which an IoT system will be deployed?
- To what extent do you take into account different users, as well as their needs and knowledge, in the development of IoT systems?
- What complexity dimensions (e.g., barriers) do you envision in your context that could hamper the application of the methodology?

DIGITISATION: ECONOMIC AND SOCIAL IMPACTS IN RURAL AREAS

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