D 1.7 Farmers perception on the proposed and running agricultural robotic systems (2)

robs4crops.eu

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Author(s)/Organisation(s)	Bertrand Pinel (TER) & Luc Dejonghe (TER)
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Abstract:	This document presents the perception of robotic systems for weeding application by farmers, on technical and non-technical aspects. 3 Co-design sessions were held in 3 of the 4 Large-scale pilots, from which the data presented in this document has been extracted. It contains a description of how the discussions were held, what subjects have been covered and the conclusions associated to them, and action points that will allow the project and external stakeholders to progress on these issues. This deliverable D1.7 will mainly be used by partners in WP1 and WP7 in this project, roboticists and external stakeholders, to know what non-technical barriers need be addressed or worked around to continue the development of robotics.

Document Revision History			
Date	**Version**	**Author/Contributor/ Reviewer**	**Summary of main changes**
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Dissemination Level		
PU	Public	**Yes**
PP	Restricted to other programme participants (including the EC Services)	No
RE	Restricted to a group specified by the consortium (including the EC Services)	No
CO	Confidential, only for members of the consortium (including the EC)	No

ROBS4CROPS Consortium			
Participant Number	Participant organisation name	Short name	Country
1	STICHTING WAGENINGEN RESEARCH	WR	NL
2	GIROPOMA COSTA BRAVA SL	GIR	ES
3	AGROTIKOS SYNETAIRISMOS POLISEOS XIRON KAI NOPON STAFYLION KIATOY KORINTHIAS PIGASOS	PEG	GR
4	SERRATER SL	SER	ES
5	SMART AGRI TECHNOLOGY BV	SAT	NL
6	TERRENA SOCIETE COOPERATIVE AGRICOLE	TER	FR
7	ABEMEC BV	ABE	NL
8	AGREENCULTURE	AGC	FR
9	AGRO INTELLIGENCE APS	AI	DK
10	FOODSCALE HUB ENTREPRENEURSHIP ANDINNOVATION ASSOCIATION	FSH	SR
11	TEYME TECHNOLOGIE AGRICOLA SL	TEY	ES
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14	KOBENHAVNS UNIVERSITET	UCHP	DK
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List of Abbreviations and Acronyms	
CoDS	Co-Design Session
EU	European Union
EUT	Eurecat
FR	France
GDPR	General Data Protection Regulation
GIR	Giropoma
GR	Greece
LSP	Large Scale Pilot
NL	Netherlands
PDL	Permissioned Distributed Ledger
R4C	Robs4Crops
Raas	Robot as a Service
ROI	Return On Investment
SER	Serrater
SP	Spain
TER	Terrena
WP	Work Package

1 Introduction

For an introduction to the project and the large-scale pilots, see the introduction to D1.1 deliverable.

The purpose of this document is to provide answers to raise barriers to the development of autonomous agricultural robots, and specifically on non-technical matters like economic aspects (such as financing and insuring robots), regulations, or incident matters. Some of these issues were raised during last year co-design sessions (CoDS).

This document is organized as follows. Section 2 provides an overview of the structure and the methods of each LSP co-design session : what subjects they covered, who attended each session, how and when it was organized. Data collected during the CoDSs is described in sections 3 and 4, after a description of the producers' interests and requirements for robotics, depending on the issues discussed, the nature of the data (Facts or Opinions) and if it raises action points workable within the project or not. Finally, an analysis of the main issues that we should address in the future will be presented in section 5 before taking a step back to check how we progressed on the non-technical matters that were raised in the CoDS from 2021.

Please note that LSP4 (Netherlands) could not organise its 2022 session as planned. Consequently, section 3 and 4 of this deliverable only include results of LSP1 (France), LSP2 (Greece) and LSP3 (Spain).

2 Structure & Methods of each Co-Design Session

2.1. Topics

The topics addressed in the co-design sessions included technical issues (such as specification of requirements) as well as non-technical issues (such as regulations and economics).

LSP1 (FR) : Non-technical matters

- Insuring the robot
- Financing the robot
- Responsibilities in case of an incident
- Regulations on the robot, including driving in the public space

LSP2 (GR) : Technical & non-technical matters

The session aims to define for LSP2 how insurance companies and banks will influence robot and autonomous tractors in viticulture. How they will interact with the vine growers about insurance rules and funds and to determine the financial side of the robot. The winegrowers were also given the opportunity to discuss more openly requests and issues that could be addressed by robots in viticulture, which have been of great concern to them recently.

- Assessment through dialogic discussion about the constraints that the robot autonomous tractor will face for its development in the viticulture, in the sectors of insurance and finance.
- Evaluation and presentation of the level of financial support that the banking system can provide to the winegrowers.
- Thorough assessment of each stakeholder's level of responsibility for incidents involving the autonomous tractor and robot.
- Identifying and documenting the opportunities and obstacles the autonomous tractor and robot will face in order to enter the viticulture market.

LSP3 (SP) : Technical & non-technical matters

- Putting an intermediary (a technician specialized in robotics for example) between the robot and the farmer
- Financing the robot
- Assessing farmers' experiences with the robot

LSP4 (NL) : Non-technical matters

The main objective is to let the associations and regulators know what type of struggles there are for farmers to start with robot technologies (like the high investment it represents), and that it's not that easy as it looks like on videos.

- Functions of hoeing robots
- Opportunities and obstacles for the development of agricultural robotics and weeding technologies
- Involvement of farmers on robotics development

2.2. Type of stakeholders and participants

LSP 1 (FR) :

Table 1 - Type of stakeholder, Organisation and name of the participants of the 2022 LSP1 CoDS

Stakeholders	Organisation	Attendees
Organizer	Terrena (TER)	Bertrand PINEL
		Luc DEJONGHE
Producers	Winegrowers	Daniel B.
		Éric V.
Crop advisors Distributors	LVVD	Benjamin G.
		Stéphane P.
		Antoine D.M.
Robotic company	AgreenCulture (AGC)	Suzanne BARON
		Marie-G. D.M.
Law makers Institutes Research	RobAgri (French Robotics association)	Stéphane D.
	Ministry of Agriculture	Christophe D.
	INRAe (research)	Philippe-S. H.
	CEA List (research)	Frédéric C.
Banks	Crédit Agricole	Arnaud R.
		Julien B.
Insurance company	Groupama	Vincent M.

LSP2 (GR) :

Table 2 - Type of stakeholder, Organisation and name of the participants of the 2022 LSP2 CoDS

Stakeholders	Organisation	Attendees
Organizer	Pegasus Agrifood Coop (PEG) (W) : Winegrower (A) : Advisor – Agronomist (F) : Facilitator	Markos LEGAS (F/ V)
		Thanos DRITSOPOULOS (A)
		Spyros K. (A)
		Giannis B. (W)
		Giorgos P. (W)
		Nikos T. (W)
		Dimitris T. (W)
		Vasilis V. (W)
		Spyros M. (W)
Banks	Optima bank	Panos M.
Insurance company	Noisis Insurance Brokers	Elias S.

LSP3 (SP) :

Table 3 - Type of stakeholder, Organisation and name of the participants of the 2022 LSP3 CoDS

Stakeholders	Organisation	Attendees
Organizer	Giropoma (GIR)	2 Field technicians
		Director
Advisor	Serrater (SER)	Raül SANCHEZ
		Venanci GRAU
Robotics / Research	EURECAT (EUT)	Jesus PABLO
Farmers	Giropoma	20 farmers

LSP4 (NL) :

The co-design session for LSP4 was scheduled for November 2022. The invited participants are listed in Table 4. Unfortunately, a large number of participants cancelled due to other obligations at a late moment. It was decided to re-schedule the session for February 2023.

Table 4 - Type of stakeholder, Organisation and name of the participants of the 2022 LSP4 CoDS

Stakeholders	Organisation	Attendees
Organizer	Wageningen University (WUR)	Bram VELDHUISEN
	SmartAgri Technology (SAT)	Jeroen WOLTERS
		Christian HEERES
		Jorick LAMBERS
Users	Profyto	Marc V.D.
Roboticists	Abemec	Casper V.O.
		Luuk B.
Law makers Institutes Research	Ministry of Agriculture	Frans L.
	Province of Groningen Province of Drenthe	Harold M. Ina W.
	AI Coalitie (Association)	Rene L.
	DAW (Initiative)	Caroline S.
	LTO (Agricultural association)	Tjeerd H.
		Marcel S.
	Wageningen University & Research (WUR)	Bram VELDHUISEN
		Else GIESBERS
		Kelly RIJSWIJK
		Koen KLOMPE
		Frits VAN EVERT / ARD N.
	NAJK (Young Farmers Association)	Leendert J.O.
Banks & Investors	Rabobank	Harjan V.D.L
	ASR real estate	Dick V.D.O

2.3. Structure and organisation

LSP1 (FR) :

Date	28/09/2022
Duration	2 hours
Structure	1. Open questions • Content : 2 open questions • Objectives : ○ To make participants know how they are involved in the development of agricultural robotics ○ To understand their perspective on agricultural robotics development issues and obstacles. 2. Focused questions : • Content : 26 questions = 9 on incidents, 12 on legislation, 2 on insurance, 3 on financing • Objective : To address non-technical issues of agricultural robotics development ➔ It is possible to find the entire list in Annex 1.

LSP2 (GR) :
The session took place at Velo Corinthias (Greece)

Date	18/11/2022
Duration	2 hours
Structure	1. Opening and round of introduction (5 mins) • Quick introduction of all participants 2. Explaining the session (10 min) • Objectives, Structure, how we will organize the discussions 3. What is the project, its objectives, what the robot and autonomous tractor looks like (Summarise its functions & impacts) (5 min) 4. Open questions (30 min) 5. Precise questions (60 min) 6. Conclusion & feedback (10 min)

LSP3 (SP) :

Date	30/09/2022
Duration	1.5 hours
Structure	1. Introduction: • Content : 1 question • Objectives : start the discussion about robotics 2. Focused questions : • Content : 2 questions • Objectives : to reveal if the participants are using robots and what are their experiences with robots.

LSP4 (NL) :

The following table describes the foreseen structure of the session.

Date	Re-scheduled to January 2023 (Initially : 08/11/2022)
Duration	4 hours 30 minutes
Structure	1. Introduction • Content : Recap of 2021 session + Review of the hoeing functions of the robot • Objective : Make a brief reminder to start the following discussions 2. Getting the farmers' perspective • Content : Discussion about opportunities of hoeing and weed control with robots + Dangers and risks of robotics for farmers + Discussion around the obstacles and opportunities for the robotics introduction at the pilot sites. • Objective : Define the opportunities and obstacles for agricultural robotics and weeding technologies development 3. The future of robotics • Content : Discussions with the stakeholders about their opinion and vision for agricultural robotics + Discussion about the opportunities among farmers – and their needs to accelerate the adoption of smart technologies • Objective : To know the opinion & involvement of farmers on robotics development, and what solution they can bring

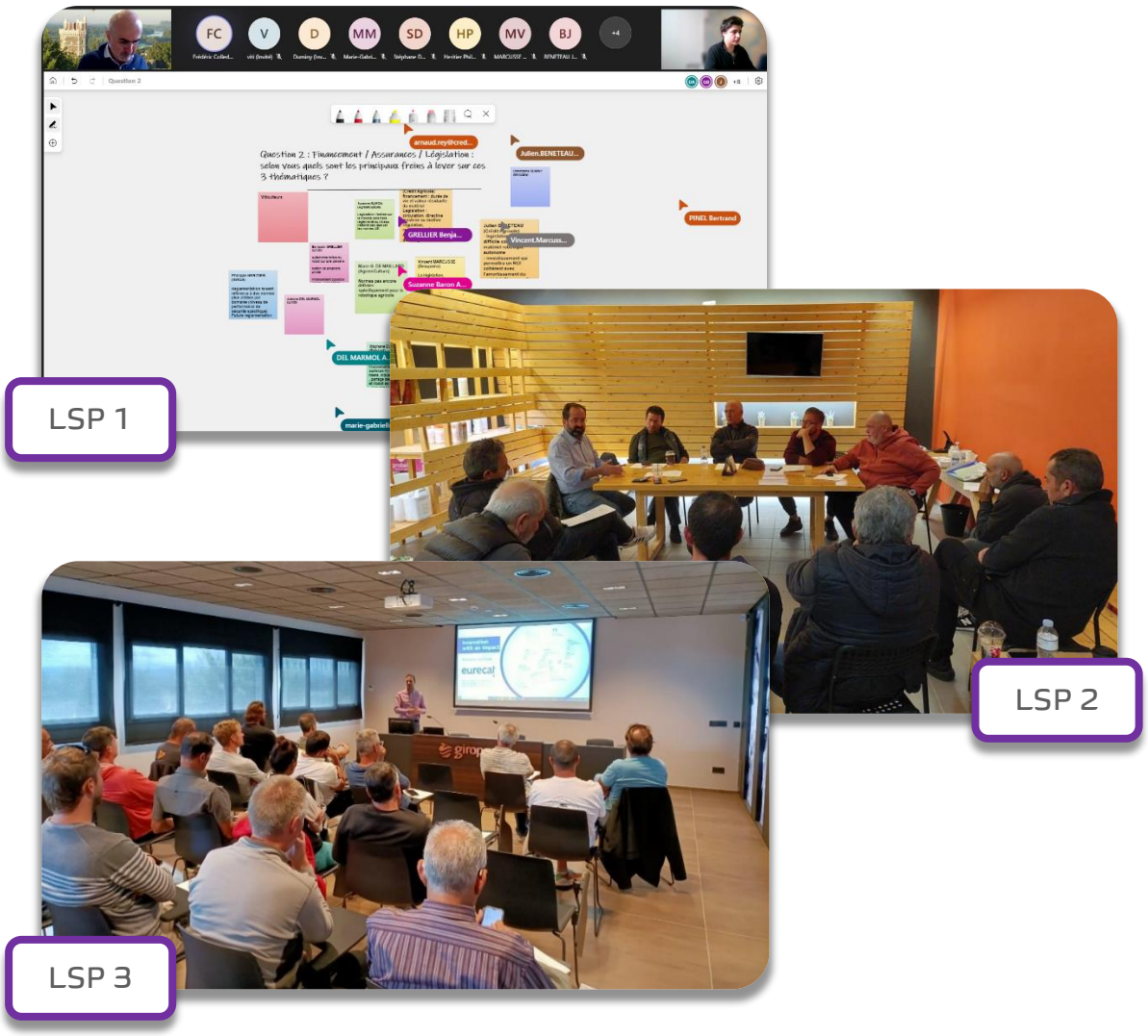

Figure 1 - Pictures of some LSP 2022 CoDS

3 Interests and requirements of the producers for the robotics – A brief reminder

All the following data has been collected during 2020 CoDS, to complete and confirm what was discussed in 2021.

3.1. Issues robotics can address

- Regulatory reduction of glyphosate use, and environmental need to reduce plant protection products. Robotics for mechanical weeding is an alternative to chemical weeding. Precision spraying is also a way to reduce chemical weeding, by only spraying diseased spots and detecting where and how much fungus is in the field.
- Lack of manpower. Robots can work many more hours than a human, for longer periods and more frequently.

3.2. Farmers' interests in robotics

1. They wish to be more self-sufficient in manpower, reduce their labour costs, and have more work capacity to be able to work more hours, thus increasing their workforce productivity.
2. They wish to become more environmentally friendly in their production. Including reduction of chemical weeding and reduction of their carbon footprint.
3. They wish to be more self-sufficient in energy, and specifically be more independent from fuel suppliers.
4. They wish to be able to collect data on their farm, to better control their crop system. They wish to have a personalized experience, in order to improve the precision of their operations (spraying in particular).

3.3. The most useful features for robots according to farmers

- Energetically autonomous (E.g.: full electric robot with solar panels).
- Environmentally "clean".
- According to the farmers, the first robots that should be developed are small robots that can work 20 hours a day, for tedious tasks like mechanical weeding.
  According to French farmers, robots that are substitutes to tractors for spraying are much bigger and are not in their mid-term objectives.
- Robots should be easy to use.
- Robots should be reliable when working alone and should be able to ensure error-free basic processes, without the need of human intervention.
- Robots should be robust. In particular, resistant bad weather (wind, rain, snow, etc.).
- Robots should have the capacity to detect internal problems in case of malfunctions.
- For wine growing, robots should be able to reduce turnaround times at the end of the rows.

4 Barriers for the development of agricultural robotics

All following information is categorised depending on its type :

Facts

Information that has been learnt reliably and is completely safe to make conclusions on. It may be facts or laws.

Experts' opinions raising issues outside the scope of the project

Information that has been obtained through expert opinions, which raised issues that are outside the scope of the project.

Experts' opinions raising issues within the scope of the project

Information that has been obtained through expert opinions, which raised issues that are within the scope of the project.

There are two kinds of action points that emerged from the discussions :

- They can be **actions points for external stakeholders**
- Or they can be **actions points for the project**

4.1. Technical issues

4.1.1. Tediousness of the use of robots

Facts

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues outside the scope of the project

- According to farmers, the robots should be able to move from field to field alone (see section 4.3.1 on the related issue about public circulation).

- According to Greek farmers, the main challenge to the adoption of robots in Greek viticulture is the technology maturity and its robustness, as most robots in operation are still tested or at the "proof of concept" stage.

- According to Greek farmers, another challenge to the adoption of robots is the ageing of the intended users.

Experts' opinions raising issues within the scope of the project

- According to farmers, the lack of hardware standards may prevent on-farm adoption, as robots will need to be able to operate across multiple hardware platforms.

- According to farmers, the robots are difficult to use today.

➔ Actions point for the project : **When building the standard models of their robots, roboticists need to build from a farmers' perspective.**
➔ Actions point for the project : **It is important to involve the farmers in the design process (already on-going in WP1 of the Robs4Crops project).**

• According to farmers, it would be useful to have an intermediary between the farmer and the robot, like a robotic technician.

4.1.2. Precision farming

Facts

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues outside the scope of the project

• According to Mr. Tsougrianis (founder member of PEG), a mobile field robot could make a difference by taking a visual survey of a vineyard at the start of the season and then use a combination of computer vision and machine learning to predict the expected fruit yield at the end of the season. With this data, the winegrower could act by using a robot to prune leaves or thin fruits to maintain an optimal balance between leaf area and fruit load. This action would ensure a high fruit quality and would reduce water and nutrient uptake.

• According to Mr. Dritsipoulos (PEG), robots could also be useful in plant breeding, by collecting data on much larger breeding experiments than what manual experiments allow.

• One issue for the field operation of automated technologies, is the diversity of nature itself : different types of weather with rain or snow, the changing colour of crops and leaves during the year, the wide variety of shapes for the same type of plant, different lighting each day, etc. Many variables and possibilities to take into account for sensors, cameras, or other smart technologies.

Experts' opinions raising issues within the scope of the project

• According to the 20 Spanish farmers who participated, the robots should be able to detect fungus and different diseases in real time in apple orchards, to really make a difference compared to classical chemical weeding. This issue has also been raised for other crops.
➔ Actions point for the project : **Adding detection tools, especially in the case of chemical weeding to develop precision spraying, should be heavily considered by roboticists.**

4.1.3. Security measures

Facts

• For new technologies, it is the Original Equipment Manufacturer (OEM) who oversees the risk assessment, to validate the conformity of the equipment that can be used in the fields and may potentially circulate on the public roads.

Experts' opinions raising issues outside the scope of the project

- According to the representative of Noisis Insurance Brokers (Greece), with time people will accept autonomous robots : In the 1920s, everybody was worried about cars and all the issues about having 400 kg machines driving on the streets that may hurt people, but in the end, everybody is using them, and it will also be the case for robots.

Experts' opinions raising issues within the scope of the project

- According to governments representatives, the main obstacle that needs to be overcome is technological, not legislative : it is the technology level and the reliability of the security measures.

➔ <u>Action point for the project</u> : According to researchers, **two main security functions must be worked on :**
  - **Detection of people or animals (or any other obstacle)**
  - **Ensuring that the machine doesn't go outside of its working perimeter**

- In Greece, some farmers consider the security and compliance of robots to be their last priority concerning this technology (they may consider it already addressed). Others consider that it is the most important aspect to keep in mind, and that a proper training for producers, but also for distributors, is mandatory in order to make everyone understand the technology and thus alleviating potential fears or errors when operating autonomous robots.

➔ <u>Actions point for the project :</u> **Provide producers and distributors within the project with dependable, detailed information on the robots' operation and the security measures that come with it.**

4.1.4. Data security / hacking issues

Facts

- Data flowing from and to the robot is always encrypted.

- According to associations representatives, hacking is an issue they are focusing on.

- It is a matter that is also included in a project launched by the French State : The "Grand Défi Robotique agricole" (The great agricultural robotics challenge), which will start in the beginning of 2023, for a 5-year period.

➔ <u>Actions point for external stakeholders</u> : **One of the challenges is to produce standardised security modules (and in particular through the funding of a project to develop standards) to mature robotics functions (perception, control, decision), with a cybersecurity component that is considered from the start of the robot construction.**

Experts' opinions raising issues outside the scope of the project

- According to governments representatives and roboticists, hacking will always be a risk, as technology is always evolving.

➔ <u>Actions point for external stakeholders</u> : **Researchers from the CEA List (France) are working on AI hacking risks of autonomous vehicles, to assess the significance of these risks, and the impact of such an incident.**

- According to the representative of Noisis Insurance Brokers (Greece), a robust

architecture based on a Permissioned Distributed Ledger (PDL)/private blockchain is needed to secure connectivity. A PDL combined with a certification process will provide trust to the end user, while ensuring openness to interconnect other equipment completing the eco-system required to operate an autonomous vehicle.

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.1.5. Data processing issues : Property, storage, and confidentiality

Facts

- In EU, this matter is covered by the GDPR (General Data Protection Regulation).

➔ **Actions point for external stakeholders : Many European projects are working on this matter, to keep the farmers' sovereignty over their data.**

➔ **Actions point for external stakeholders : In France, this matter is being addressed at national level.**

Experts' opinions raising issues outside the scope of the project

- According to INRAe researchers (France), the way data obtained by the robot is processed depends on what is agreed between the farmer and the equipment vendor.

- AGreenCulture roboticists stated that only the cadastral data, obtained by land surveying to limit the plot, is mandatory for the CEOL robot, and therefore raises the issue of the data's confidentiality and the farmer's sovereignty on his robot's data. In the future, it is possible that more data will be used, like camera feedback or technical operations planning.

Experts' opinions raising issues within the scope of the project

- According to farmers, a lack of coordinated data may prevent on-farm adoption, as there is a need for robots to be able to operate across multiple software platforms.

- According to farmers, the data that robots collect are difficult to understand today. It will require appropriate talent, available skilled resource, or training for farmers to be able to properly use and understand the produced data.

➔ **Action point for the project : When building the standard models of their robots, roboticists need to build them from the farmers' perspective.**
➔ **Action point for the project / external stakeholders : Data management training for farmers should be made available by manufacturers when the standard models of robots go on the market.**

4.1.6. Field compatibility with robotics

Facts

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues outside the scope of the project

- According to advisors and roboticists, all plots aren't compatible with robotics.

E.g. : If the robot needs to make a U-turn on a public road when going from a row to another. (Issue reported in section 4.3.1 on traffic regulation).

- According to roboticists, if the robotizing of a plot doesn't bring any added value, then the plot shouldn't be robotized.

Experts' opinions raising issues within the scope of the project

➔ Action point for the project : **Advisors or robot sellers need to develop a diagnostic tool, to ensure that using robots on the plot brings added value compared to classical weeding**

4.2. Economic issues

4.2.1. Financing robots

Facts

- The French bank "Crédit Agricole" has already financed a few dozen of autonomous robots, like the FD20 from Farmdroid.

- The prices of robots can reach 200 000€, which represents a very high investment for producers.
Joint purchases are considered by Spanish farmers.
Greek winegrowing consists of many small businesses with limited access to capital for business development.

- According to French associations representatives, financial support generally comes from the Regions, with national or EU fundings

- According to French associations representatives, Pre-production units received aids from the State in some cases.

Experts' opinions raising issues outside the scope of the project

- The life span, the residual value and thus the Return on Investment (ROI) of robots are not yet known, as we don't have a lot of hindsight on robots yet.

- The depreciation of autonomous robots is a similar issue. According to banks representatives, it should be situated between :
  - Computer depreciation = 2 years
  - Milking robot depreciation = 10 years

➔ Actions point for external stakeholders : **Since the number of robots on the market**

is low, it will be necessary to wait for feedback from the field, in order to get information on the depreciation period and the ROI of robots.

- According to farmers, the use of environmentally "clean" robots could be helped by a small reduction of taxes for the farmers.

- According to farmers, they would need some public financial support to purchase or use robots

➔ **Actions point for external stakeholders : The French association "RobAgri" is working on this matter**.

Experts' opinions raising issues within the scope of the project

- Will the product of the vineyard have an added value thanks to the use of an autonomous robot ?

- Some farmers are not convinced by the economical profitability of robots.

➔ **Actions point for the project : Provide producers within the project with dependable, detailed information on the costs and benefits of using robots.**

4.2.2. Insuring robots

Facts

- Insuring autonomous robots with a third-party liability insurance, is required by law.

- Insurance companies do cover the potential damages robots could do to crops during operation.

- Insurance companies also cover all kind of theft incidents in their insurance solutions for robots.

- Insurance companies propose hacking risks insuring solutions.

- The French insurance company "Groupama" is already insuring several autonomous robots.

Experts' opinions raising issues outside the scope of the project

- According to Insurance companies' representatives it is their job to estimate losses caused by a robot that would have deviated from his original trajectory. But they are confident in the robot's algorithms.

Experts' opinions raising issues within the scope of the project

- According to insurance companies, some farmers do not have their robot insured, because they do not know that insurance solutions are available, or don't need to ask themselves the question. It is particularly true concerning small robots, such as "Oz" from Naïo technologies, or "Spoutnic", as they represent a smaller investment or are working inside buildings, and thus are not exposed to an un-controlled environment.

➔ **Actions point for the project : Provide producers within the project with dependable,**

detailed information on insuring requirements and solutions.

4.3. Social / Regulatory issues

4.3.1. Existing laws for autonomous robots

Facts

- In EU all machines, like robots, must comply with the Machinery Directive – 2006 42 CE.

- No specific standard exists for agricultural robots. However, such a standard is under development within the EU. This has to be achieved in consensus between manufacturers, preventionists, experts, and authorities.

  The technical specifications given by the new standard will enable the manufacturer to comply easier with the regulations.

- 4 types of machines exist legally :

  Ride-on machines : the driver is carried by the machine (e.g. : cars)

  Walk-behind machines : the driver walks next to the machine, and holds it with handles (e.g. : lawnmowers)

  Remote-controlled machines : the machine is driven remotely, and the driver must have direct sight of it. The connectivity between the remote and the machine must be 100% reliable and have security protocols (e.g. : the machine stops when the controller is not held).
  → The driver is responsible for the machine during operation

  Autonomous machines : no interaction with an operator, the robot ensures reliably all elements of safety.
  → The manufacturer is responsible for the machine during operation

Experts' opinions raising issues outside the scope of the project

- According to producers, roboticists, and insurance representatives, Legislation is the main obstacle that needs to be worked on, to ensure that the legal requirements to get autonomous machines onto the market are not cumbersome.
  Specifically, it is the regulation on the driving of the robots on public or private roads.
  E.g. : it is not allowed for autonomous robots to drive on public roads, whatever their nature.

➔ **Actions point for external stakeholders : It is an issue on which regulators are working on.**

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.2. Effect of the Size of the robot in the regulation

Facts

- The size of the robot doesn't matter, all machines follow the same machine regulation. On the other hand, the risk assessment (which is mandatory) won't be the same depending on the size of the machine. But it considers other characteristics than size, like the machine's functionality.

Experts' opinions raising issues outside the scope of the project

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.3. Place of retrofit kits within the regulation

Facts

- A tractor goes on the market after being approved : it conforms to the approved type.

➔ Modifying the tractor = making it non-compliant to the approved type
= It is a risk, according to the law.
= it makes the buyer outlawed from the labour code
= A company cannot entrust it to an employee, nor can it circulate near him.
= The full responsibility of every incident encountered by a tractor modified this way will go to the user.

➔ It is a subject that has been discussed within the EU commission on the 12 October 2022.

Experts' opinions raising issues outside the scope of the project

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.4. Responsibilities in case of incidents

Facts

- If the equipment is not complying with the regulation : the manufacturer is responsible.

- For autonomous machines, operating autonomously : the manufacturer is responsible.

- For autonomous machines, operated manually : the user is responsible. It is also true for autonomous cars or any autonomous vehicle.

Experts' opinions raising issues outside the scope of the project

- According to the representatives of the French association RobAgri, incidents responsibilities and prevention, like a machine that would spontaneously catch on fire, are issues that should be worked on at a broader scale than only robots : it also concerns any autonomous vehicle.

➔ **Actions point for external stakeholders : According to them, the manufacturers already started working on this issue.**

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.5. Theft incident issue

Facts

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues outside the scope of the project

- According to insurance companies' representatives, theft is less likely in the case of robots, as less people know how to use it.
  According to them, the risk of a theft is higher on the components of the robot.
  According to them, the risk of a theft is higher on smaller robots.

- But according to researchers, theft risk is higher for autonomous robots than for tractors, as the farmer won't always be around the robot to monitor it.

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.6. Hacking incident issue

Facts

- The full responsibility of this incident will go to the person who hacked.

Experts' opinions raising issues outside the scope of the project

// No data was extracted from the CoDS for this part //

Experts' opinions raising issues within the scope of the project

// No data was extracted from the CoDS for this part //

4.3.7. Social issues

Facts

- People do not trust autonomous robots today.

Experts' opinions raising issues outside the scope of the project

- According to Marcos Legas (PEG), winegrowers only have around 40 years (or "attempts") in their lifetime to "get things right" for their vines, so they won't take a lot of risks regarding new technologies that are not fully mature yet. So, it will take time seeing robotics working, for them to be willing to take the production risks associated with relying on computers and algorithms to make decisions for them.

Experts' opinions raising issues within the scope of the project

- Some people, including farmers, do not trust robots can be environmentally "clean".

5 Conclusion & Final analysis

5.1. Lessons from this year

The interests and the requirements of farmers for agricultural robots, discussed in 2021, have been confirmed this year. Mainly, they wish to address the lack of manpower issue, as well as the environmental problems that classical spraying may cause. Secondly, the robot should bring them energetic autonomy, reduce their carbon footprint, and be able to improve their precision farming. On a side note, some farmers expressed the need to have an intermediary (an advisor or a technician) between them and the robot, who would be the one in charge with the robot's operation and maintenance (which could take form of a "RaaS", Robot as a Service).

Then, we learnt that the non-technical matters concerning robotics are still under development :
some of them are still being worked on, like the regulation. National laws specific to autonomous agricultural robots do not exist yet, and the EU Machinery Directive is being revised. Also, in most EU countries the traffic regulation does not allow autonomous vehicles to drive themselves on public roads. Security measures and the technologies related to them are in development as well, as they are not completely reliable yet, thus compromising the autonomous aspect of robots.
Some of the matters that were studied brought surprising answers. It is particularly true for the two following issues.

- On the economic side, a French bank and a French insurance company are already greatly interested in robotics development, as well as financing and insuring commercialized robots.
- On the regulation side, we learnt that autonomous robots do not legally need to be watched or supervised when they are operating in the field, according to the law. The roboticists (robot manufacturers or developers) are the ones who make it mandatory, as their security technologies are not yet ready.

→ What are the major differences and similarities between LSPs, countries and robots ?

- Financing issue : in France and Greece, the financing of robots is an important concern but not the main one, as farmers are confident solutions will be developed. In Spain, it is one of their most important concerns, if not the main one.
- Farmers' interests : in France and Spain, the environmental improvement robotics can bring are a point of interest. In Greece, it has not been discussed this year.
- All farmers, from all LSPs, are interested in autonomous robots for one main reason : to address the labour shortage and its rising costs.

5.2. What progress regarding 2021 issues

<u>Regarding technical issues</u>
Technical issues were discussed less in the 2022 co-design sessions than in 2021. Some issues, such as security measures, data management or precision spraying were still addressed, at least partially (section 4.1.).
Still, a lot of the technical issues that were raised in 2021 have been continued to be discussed in 2022 inside each LSP, allowing them to learn and adapt according to the farmers' opinions.

Regarding the non-technical issues
All issues raised in 2021 CoDS can be found in Annex 1, describing the questions used by most LSPs in 2022 as a reference, with some additional issues that were raised during 2022 experiments.
A good part of them have been addressed :

- All issues on Responsibilities and Incidents (damaged crops, damaged robot, injuries on people, theft, hack), mainly in section 4.3.
- The issue of robot transportation and driving on public roads.
- Clarification of existing laws about autonomous agricultural robots. It is important to note that, in addition to the answers we got in section 4.3, deliverable D1.3 of this project specifically covers the safety and regulatory framework of each LSP.
- Insuring issues (section 4.2.2.)
- Most financing issues (Depreciation in particular), in section 4.2.1.

5.3. What still needs to be addressed

Some issues raised in 2021 were not addressed in 2022, or need to be discussed further :

- Details on the financing issue, like subsidies, are still a subject that needs to be studied.
- Details on the regulation, like the need of a special license or formation, how will local jobs & robots be regulated, will robots have an impact on taxes because of their low carbon footprint.
- Details on the social aspects, like the use of robots at night, or the impact of robot's usage on the food price.
- Data management details : storage, ownership, and confidentiality.

In addition, all action points presented in the section 4 are topics on which external stakeholders or the Robs4Crops project may need to work.

These remaining issues are the reasons why more Codesign sessions need to and will be organized in 2023 within the R4C project, with similar participants, so they can be addressed further.

5.4. How to improve our methods

In France, the restricted time during which the session has been organized, combined to the great geographical distances between the participants, has led to the session being held remotely. Even though the session went well, improving our tools for its organization would better our results and the session flow. Holding the session face-to-face would also improve both aspects.

On a more general note, in the future Codesign sessions, it may be interesting to prepare some common questions for each CoDS, to be able to compare them reliably, and see what differences or similarities they have.

Annex 1 – Reference questions to ask during 2022 CoDS, based on issues that were raised in 2021 CoDS

Open questions (to ask at the start) :

1. Why does robotics interest you ?

2. Funding / Insurances / Legislation : in your opinion, what are the main obstacles to be removed on these 3 topics ?

Focused questions :

1. If something happens to the robot on the field, or there are curious people who go and look at the robot on the field, and something goes wrong, who is liable?

2. Is the robot treated differently depending on its size ?

3. Are retrofitted tractors treated differently than robots ?

4. If the robot damages some valuable crops : who's responsible ?
    - Damaged crops ?
    - Destroyed crops ?

5. In the event of an accident with people, who is responsible for what ?
    - Accident involving external people :
        - Without injuries ?
        - With injuries ?
        - With death ?
    - Accident involving the Winegrower :
        - Without injuries ?
        - With injuries ?
        - With death ?

6. If the robot is damaged, who is responsible for what ?
    - When operating autonomously ?
        - If the robot is damaged ?
        - If the robot is destroyed (severe damage) ?
    - When operated manually ?
        - If the robot is damaged ?
        - If the robot is destroyed (severe damage) ?

7. Who's reponsible in case of malfunctions ?
    - Mechanical malfunction ?
    - Navigation malfunction ?
    - Network connectivity malfunction ?

8. What happens in the case of a theft ?

- Theft of the robot :
  - on the farm ?
  - in the field ?
- Theft of pieces of the robot :
  - on the farm ?
  - in the field ?

9. What happens in the case of a hack, who's reponsible ?
   - Would the data be insured ?

10. Would the State / banks / insurances help winegrowers invest in such robots, and how ?

Specific to Legislation :

Open question (valid for each specific question) :

11. What is expected, as a matter of priority and urgency ?

12. How should/could regulations be adapted to make robots practical for farmers to use?

Specific questions :

13. What formation / license would be necessary to drive or own such a robot ?

14. Robots & local jobs : how would that be regulated ?

15. Any laws or rules applied to prices of the food produced with a robot ?

16. Would the robot decrease taxes on carbon footprint ?

17. Transportation :
    - Would a robot be able to drive itself on public roads ?
    - Or be driven remotely on public roads ?

18. What would prevent the robot from working at night ? (Except the noises it makes ?)

19. Would it be authorized to handle a robot battery by hand ?

20. How the data obtained by the robot will be processed ?
    - How will the data be stored ?
    - Who will be the data owner ?
    - How will confidentiality be managed ?

21. Would a regulation on software & connectivity standardization be possible ? (like on tractors today ?)

Specific to Insurances :

22. What would the insurance cover ?

- At what price ? What difference with a tractor ?

23. How to insure the robot ?

Specific to Banks :

24. How to buy a robot with the banks ?

25. Do banks trust this technology economically ?

26. Will the depreciation of the CEOL robot be over 3, 5, 7 years or more ?