FLEXIGROBOTS

D2.1 Stakeholder view to FlexiGroBots system scenarios

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List of Abbreviations

Abbreviation / acronym	Description
AI	Artificial Intelligence
Dx.y	Deliverable number y belonging to WP x
EC	European Commission
EU	European Union
GPS	Global Positioning System
IDSA	International Data Spaces Association
LPWAN	Low Powe Wide Area Network
NDVI	Normalised Difference Vegetation Index
ROI	Return of Investment
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
US	United States
WP	Work Package

Executive Summary

This deliverable summarises the results of the FlexiGroBots project's stakeholder analysis done in task 2.1. The objective of the analysis was to understand how stakeholders view the project, its objectives, and planned outcomes. The results will guide the FlexiGroBots platform specification work to be done in Task 2.2.

The stakeholder analysis was done using a Google Forms questionnaire with 72 questions addressing the needs and opinions related to the FlexiGroBots project's objectives and platform features. The questionnaire was distributed using email to project partners and their contacts that were considered relevant for the project. About 60 replies were received and analysed.

The main finding of the analysis was that robots and AI are seen as a natural evolution in the domain of agriculture. Farmers are familiar with using digital tools and robots, and AI services are seen as such. Data spaces and data sharing were seen as tools for achieving higher in-depth situational awareness of the farm through AI services, augmented maps, and advanced analytics services. The future of agriculture and food production is in precision farming and transparency of the food production value chain, and data is the main enabler for them.

The survey confirms the main approach in the FlexiGroBots platform. All three main elements: AI services, automation through agricultural robots, and data spaces are relevant in the project use cases and future farming. The analysis of results also clarified the need to take into account the ethical assessment and business modelling aspects in platform specification.

1 Introduction

1.1 Purpose of the document

The purpose of the document is to present the implementation and results of the stakeholder survey related to users' opinions and expectations for FlexiGroBots. This information is targeted to help the formulation of the project's targets and platform definition. It also helps to better understand how automation and AI are seen in the agricultural domain, and what needs to be emphasised when business models and exploitation of these services are planned.

1.2 Stakeholder survey process

The project decided to implement a stakeholder survey for having a proper understanding of the stakeholders' views and expectations related to the FlexiGroBots platform and to the use of multi-robot fleets, data space-enabled data sharing, and AI services that are based on farmers data.

The list of possible stakeholders is huge in this kind of project. We decided to implement the survey as a web questionnaire as it is an efficient way to have adequate coverage and participation. Personal interviews would naturally give more in-depth results but implementing them in such a multi-cultural project as FlexiGroBots with enough coverage would have exceeded the project's capacity.

We ended up defining the major stakeholder categories and creating a list of target persons using the project members as stakeholders, their professional contacts, and contact lists of Digital Innovation Hubs related to the project. Among the respondents, there were farmers, scientists, AI developers, tool and robot manufacturers, etc.

The questionnaire was developed using Google Forms as a tool. It consisted of both multiple-choice questions, selection questions, and open questions. The questionnaire was distributed using e-mail. We received 60+ replies, analysed them, and the results are shown in the following sections.

1.3 Structure of the document

This document is structured in 5 major sections:

Section 2 presents the methodology for the survey and its analysis.

Section 3 presents the survey results divided into subsections of AI, data and robotics, multi-robot fleets, data spaces, and the FlexiGroBots platform.

Section 4 presents the discussion of the results.

Section 5 draws the final conclusions of the survey.

2 Description of methodology

The methodology that was followed by FlexiGroBots partners to collect and analyse inputs and requirements from the stakeholders was based on a process composed of eight steps:

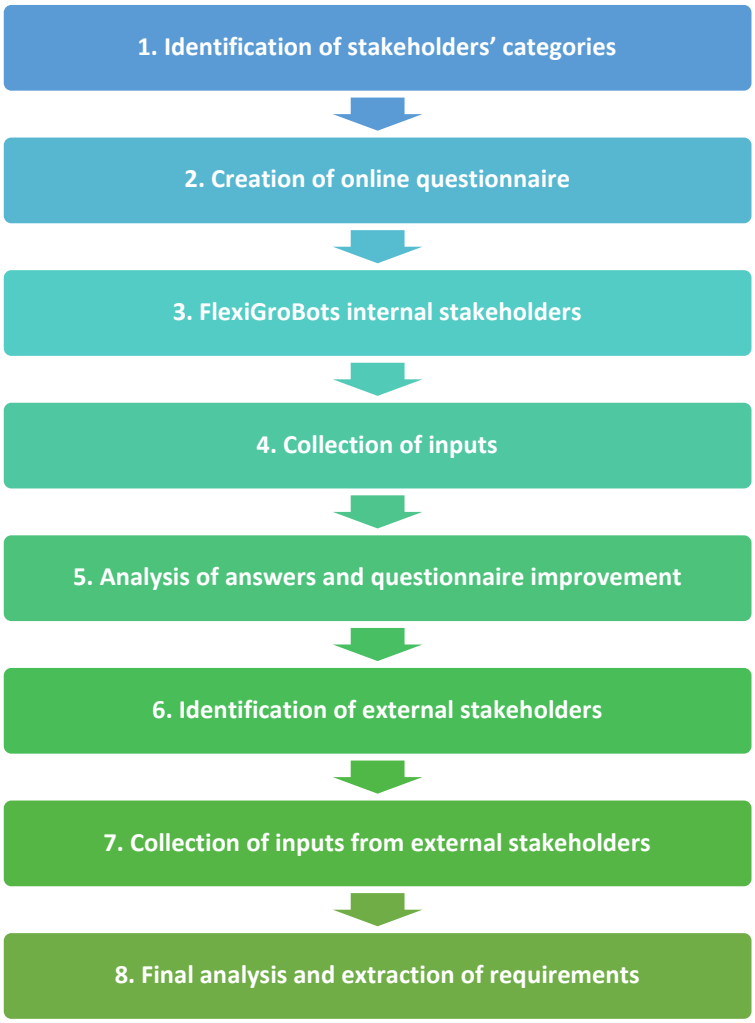

Figure 1. Survey process.

1. Identification of the groups and categories of stakeholders that are in the position to help in defining the expected requirements for the FlexiGroBots system.
2. Preparation of the online survey including questions to sense the needs and the views of the stakeholders with respect to the objectives of FlexiGroBots. To reduce the carbon footprint of the questionnaire and to minimise the burden on the target actors, a software version using Google Forms was prepared. This action was performed under the coordination of VTT as the T2.1 leader and all the project partners participated in order to refine and improve the questionnaire. The survey was available in English.

3. The questionnaire was circulated among FlexiGroBots partners to receive the first round of inputs since the consortium includes a representation of most of the identified stakeholders.
4. A period of time of one month was given to the FlexiGroBots partners to prepare their input for the survey, including contributions from the teams that do not participate actively in the project.
5. The feedback received through the survey was analysed to extract conclusions to feed into the FlexiGroBots design and implementation, but also to improve the survey itself.
6. To expand the complementarity, scope and completeness of stakeholders' requirements that the consortium takes into account for the design of the system, we decided to create a wider network that also included external actors. All project partners were asked to propose at least 5 different actors to be reached during the process.
7. The improved and extended version of the survey was circulated again in July 2021 and the external stakeholders were asked to provide inputs until the end of August.
8. The final assessment and evaluation of the answers were performed collaboratively by all partners participating in T2.1, resulting in the content of the present deliverable D2.1.

2.1 Survey questionnaire

The survey questionnaire was implemented in Google Forms. It consisted of the following sections:

1. Background questions
2. Opinions on AI and robotics
3. Multi-robot fleets
4. Agriculture data spaces
    a. Data space characteristics
    b. Data space properties
5. FlexiGroBots platform
    a. FlexiGroBots platform services

The number of individual questions was 72. The objectives of the different types of questions were to get new ideas, to understand what issues are important, and to understand the priorities of issues respectively. The questionnaire is included in Annex 1.

3 Survey results

The survey was executed in two phases. The first was among project partners and the second was targeted to a set of stakeholders that were selected by project partners. The question sets had some minor differences, but it was fairly easy to combine the answers. We received 63 replies in total. The survey was anonymous and no other information outside the direct questions was collected.

3.1 Background of respondents

The distribution of the respondents' background is shown in Figure 2. As this is a research project, it is no surprise that most of the answers (53%) came from research or advisory organizations. About 30% of replies came from technology and service providers and about 16% from farmers or farming experts. It is noticeable that only 1,6% of respondents had a background in robots manufacturing.

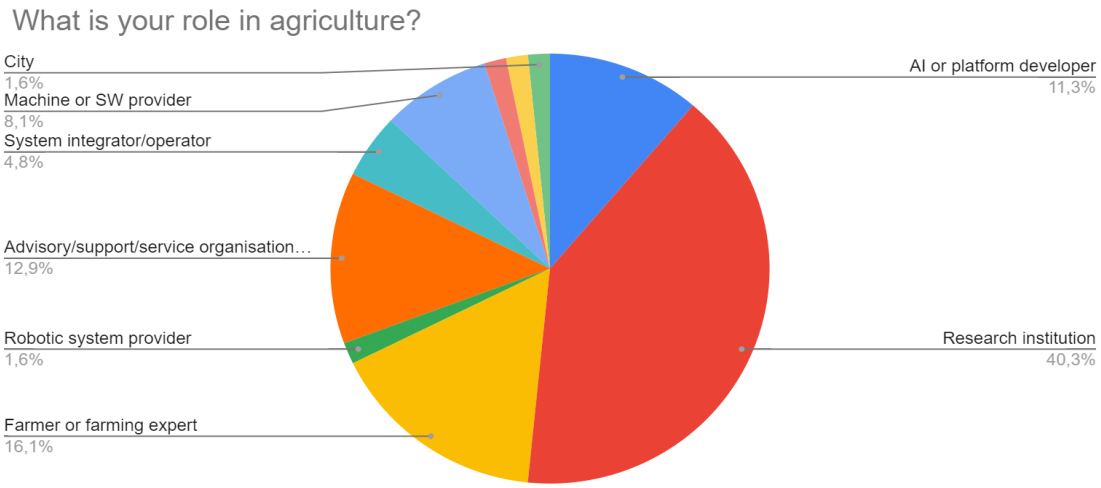

Figure 2. Distribution of the roles of the respondents.

3.1.1 Expectations to market entry

The time of the expected market entry of multi-robot operations was asked. As alternative answers, we had years from now until beyond 2030. We got 21 replies with the following distribution:

- Now: 15 %
- Around 2025: 18 %
- By 2030: 53 %
- Later 9 %

- No idea: 5 %

As we did not have very many replies some categories are grouped as one. Interestingly, more than 60% answered that it will take about 10 years before these technologies are in common use.

3.2 AI, data, and robots

Most of the physical work currently done in agriculture will be done using robots

Most of the received answers in the online survey demonstrate that relevant stakeholders envision that robotics systems will replace human workers in the execution of tasks that require physical work.

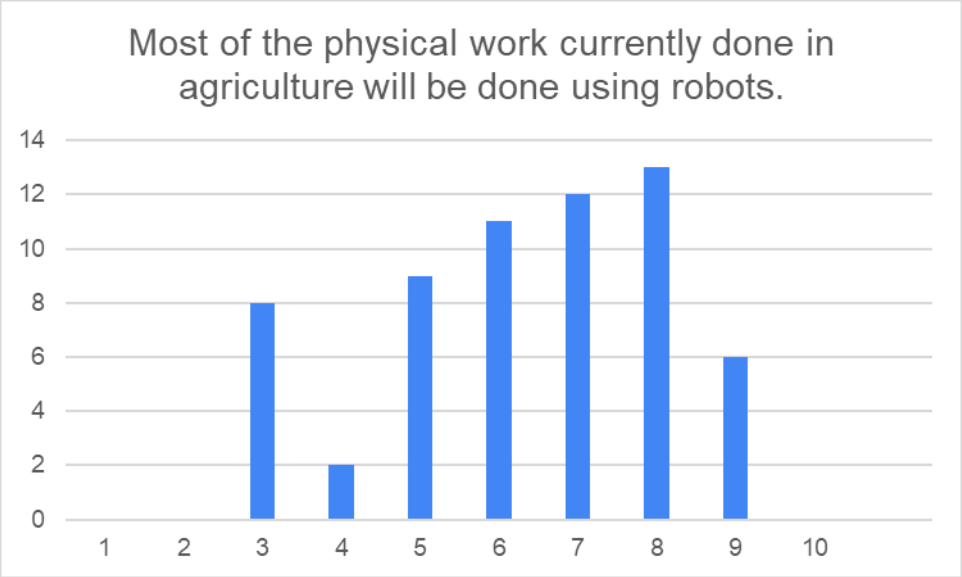

Figure 3. Distribution of opinions on whether most of the physical work will be done using robots. 10 = totally agree, 0 = disagree.

This role of agricultural robotics systems may be seen as a way to improve the conditions of farmers in the current context, making this activity more attractive, as it is essential to fight against the abandonment of rural areas that is affecting wide areas of the European continent. Nevertheless, automation of agricultural tasks also brings a dilemma that is common to many other sectors where AI systems will bring a complete revolution: what will happen with manual workers that currently do most of the physical work in agricultural crops? Indeed, it must be considered as part of the discussion the fact that this group of people normally does not have specialized digital skills and they will need to receive training to adjust to the new paradigm of digital agriculture.

Different reports and articles have been published during recent years to analyse the pros and cons of this process. In some cases, it is reported that the current state-of-the-art of technology does not make it possible to implement completely autonomous robots, especially for harvesting purposes that require high accuracy in recognition of the products, speed in the process, and dexterous manipulations to avoid damages in managing the fruits or vegetables, all at the same time. Therefore, the most likely hypothesis for the coming years is to move towards a close collaboration between human operators and robotics systems [1][2][3].

Data collected from the farm will play important role in the value of the final food product

Nowadays, the world is living in an era of instantaneous and ubiquitous information. The plethora of smart devices that facilitate access to the Internet at any moment and place allow obtaining detailed data about any product or process. Moreover, consumers are more and more interested to know the details about the food they buy and eat. They do not rely on well-known brands or media advertising anymore and they want to know what the environmental impact of the whole value chain from farm is to fork, to have the capacity to query transparent and immutable data about individual items or lots, etc. Indeed, some initiatives in this sense have been implemented during the last years. E.g., Carrefour is using blockchain to guarantee product traceability [4], Food and Drug Administration of the United States launched a challenge so that winners proposed mechanisms to achieve end-to-end traceability – from source to table – throughout the food safety system [5].

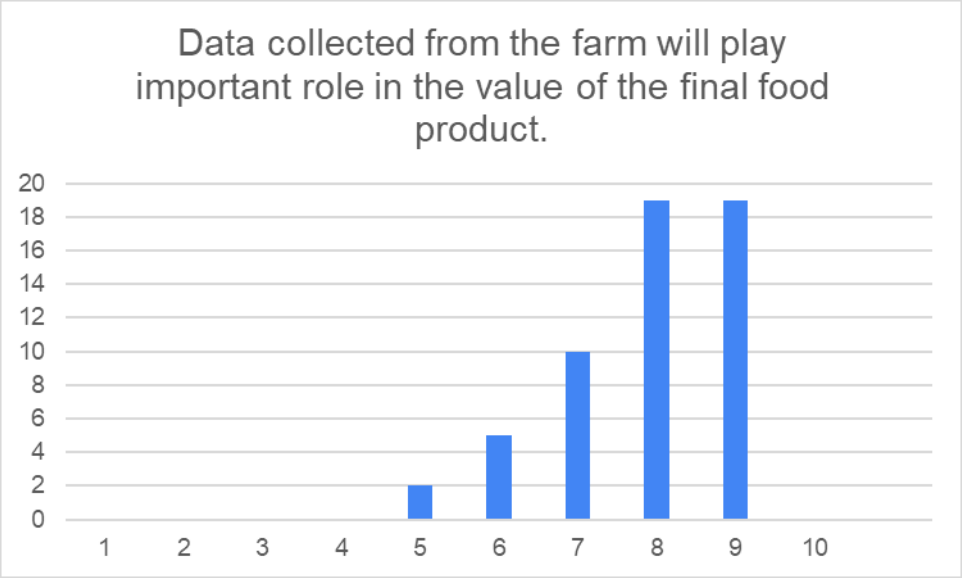

Figure 4. Distribution of opinions on the importance of the role of data. 10 = totally agree, 0 = disagree.

Nevertheless, the use of agricultural data goes beyond just transparency and traceability. It is being currently exploited to develop new services to increase the productivity of the farms, to make a more accurate and efficient application of fertilisers and pesticides, to detect pests and diseases at an early stage, to predict the yield, etc.

Robotics systems, including both aerial and ground vehicles, will be powerful mechanisms to collect high-quality data in an affordable manner, even in parallel to the autonomous execution of certain tasks.

Data collected from the farm can be sold as a separate asset

Participants in the survey seem to be optimistic about the possibility that farmers may find an additional stream of revenue through selling agricultural data as a separate asset. Nevertheless, as can be seen in the provided inputs, there are also doubts with respect to this hypothesis.

Agriculture was also affected by digital transformation in the last decades. Indeed, it is possible to find automated tractors in the market from big manufacturers such as John Deere or Monsanto. They incorporate GPS and multiple sensors that collect data from the soil and crops, uploading the information directly to the cloud. The dilemma is not new, the US Farm Bureau published an article to provide guidelines about privacy and security for farm data [6]. Data sharing in a secure and sovereign way is one of the barriers that must be addressed to make it possible to do business with farm data. This concern has been also raised by scientific publications [7], which identified five main points:

1. Terms of use in data licenses are not transparent enough.
2. Uncertainty with respect to ownership of shared data.
3. Privacy concerns.
4. Unbalanced negotiation power between the stakeholders involved.
5. Unbalanced benefit-sharing between data providers, aggregators, and service providers.

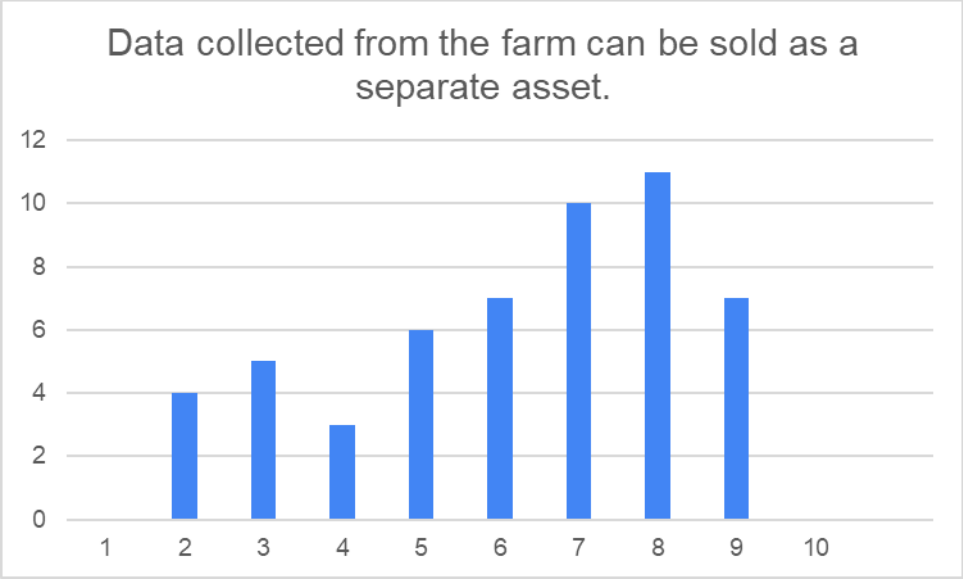

Figure 5. Distribution of answers weather data will be a sellable asset in farms. 10 = totally agree, 0 = disagree.

Beyond research and innovation projects, some initiatives can be found for the monetization of agricultural data. This is the case with FarmMobile that remunerates farmers for sharing their data [8]. Nevertheless, there are no clear successful business cases about agricultural data sharing between several farmers that boost this process.

Precision farming will be the dominant approach in food production

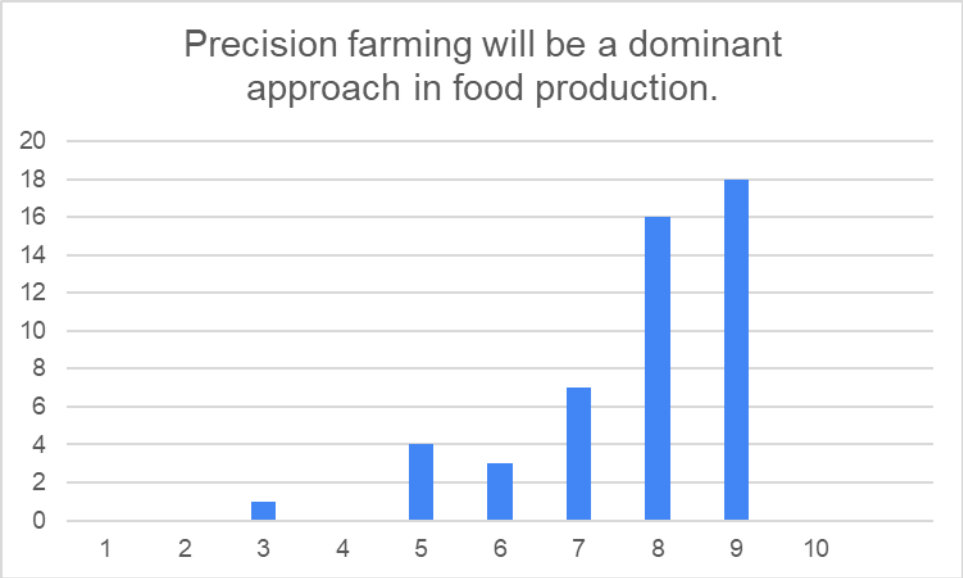

Figure 6. Distribution on opinions about the claim that precision farming will be a dominant approach. 10 = totally agree. 0 = disagree.

Despite a few outliers, a clear majority of the inputs received show that new paradigms for precision agriculture based on digital technologies like IoT, Artificial Intelligence, Geospatial images and heterogeneous robotics system will be dominant in food production. In fact, multiple examples of precision agriculture operations are already in place to optimise yield, improve sustainability, reduce time to market, identify risks in the supply chain, etc.

Although there is almost consensus with respect to the importance that precision farming is going to have in the medium and long term, there are still some barriers that must be overcome to completely realise this concept [9][10][11][12]:

1. Legacy and old equipment must be interconnected or updated.
2. Lack of digital skills and knowledge about new technologies within the end-users.
3. The small size of many farmers that do not have the economic capacity to fund the required investment. In some cases, they do not see the need to introduce new technologies and change their current practices.
4. Reluctance to change traditional procedures that have been in use through many years and even through several generations of farmers.
5. The negative experience of customers with early products that did not satisfy their needs.
6. The pressure of day-to-day business and low-profit margins.

7. The topography of the crops limits the use of currently available commercial robots and precision agriculture services.

Food production needs almost real-time data about the condition of crops and the presence of diseases or pests in the surrounding areas

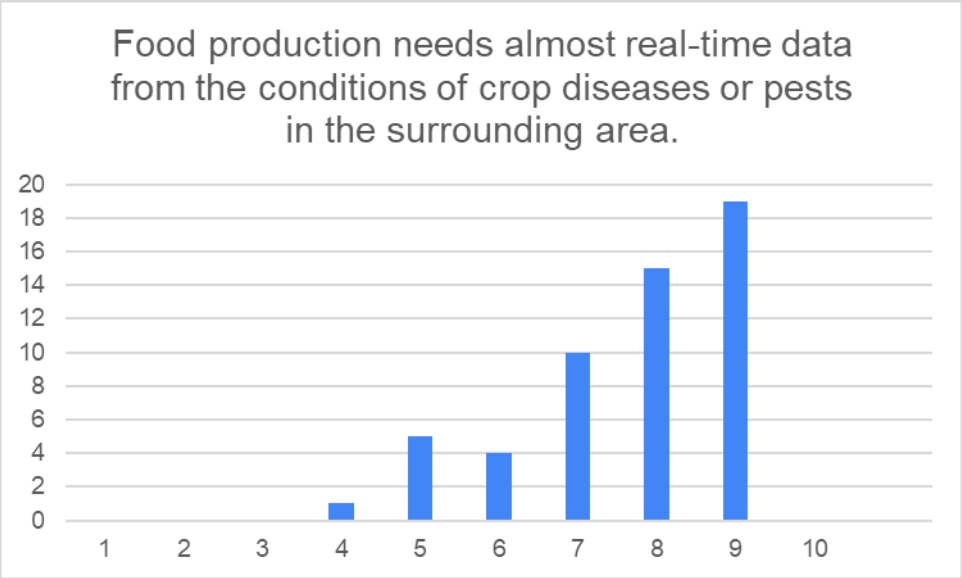

Figure 7. Distribution of answers to the claim that food production needs near real-time data on diseases and pests. 10 = totally agree, 0 = disagree.

Once again, the participants clearly indicated that in order to achieve more efficient and sustainable food production, having near-real-time data about the condition of crops will be required. In recent years, the evolution of more intelligent, affordable and energy efficient IoT sensors has enabled us to boost the collecting of richer sets of information about the crops. Also, progress on Low Power Wide Area Networks (LPWAN) has reduced the complexity and costs of deployment and maintenance of the communication infrastructure. It is complemented by the availability of satellite images provided, for instance, by the Copernicus programme. The immediate result is the improvement of the monitoring capabilities of the farmers and the possibility to implement informed decision-making practices based on data analytics. Nevertheless, the introduction and interconnection of fleets of heterogeneous robots that autonomously execute certain operations in the fields, while obtaining information with onboard sensors and cameras or acting as a gateway will increase the amount of available information through less intrusive and complex technological systems.

Transparency of food production will be very important

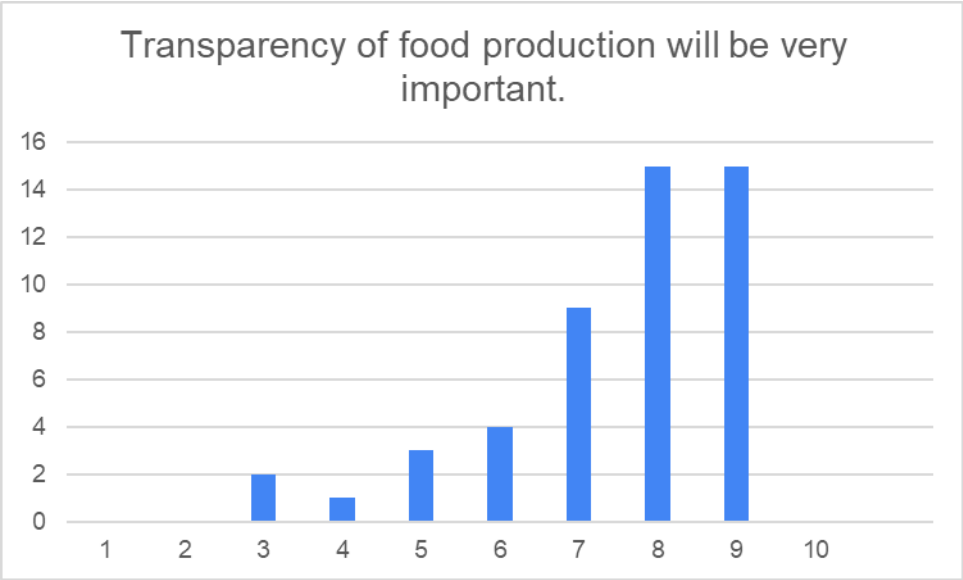

Figure 8. Distribution of answers to the claim that transparency is needed in food production. 10 = totally agree, 0 = disagree.

The need for having transparent and non-repudiable information from farm to fork was already discussed as one of the reasons to promote and invest in data sharing mechanisms. This need is newly emphasized in the answers obtained in the stakeholders' survey for both internal and external participants. FlexiGroBots outcomes will facilitate obtaining information from heterogeneous agricultural systems and allowing a controlled mechanism to exchange the data through an IDSA compliant Data Space.

Prices vs quality will remain the most important aspect for customers

It cannot be denied that costs and prices have a really deep impact on the agricultural and food production domains. The globalisation of the economy has broken the barriers between countries and nowadays consumers can find fruits and vegetables in the supermarket, which are cultivated and harvested even on different continents. It is also true that in recent years, more people are becoming aware of the effects that climate change is having on the world right now and this includes trying to minimise waste, buying proximity products with a smaller carbon footprint and analysing the production processes. Although this change of consumption habits is growing, it may take some time to completely materialise. In the meantime, European farmers must fight to produce high-quality products while containing costs, since the profit margins are at the lowest point and an increase in costs may lead to huge disruptions in agriculture.

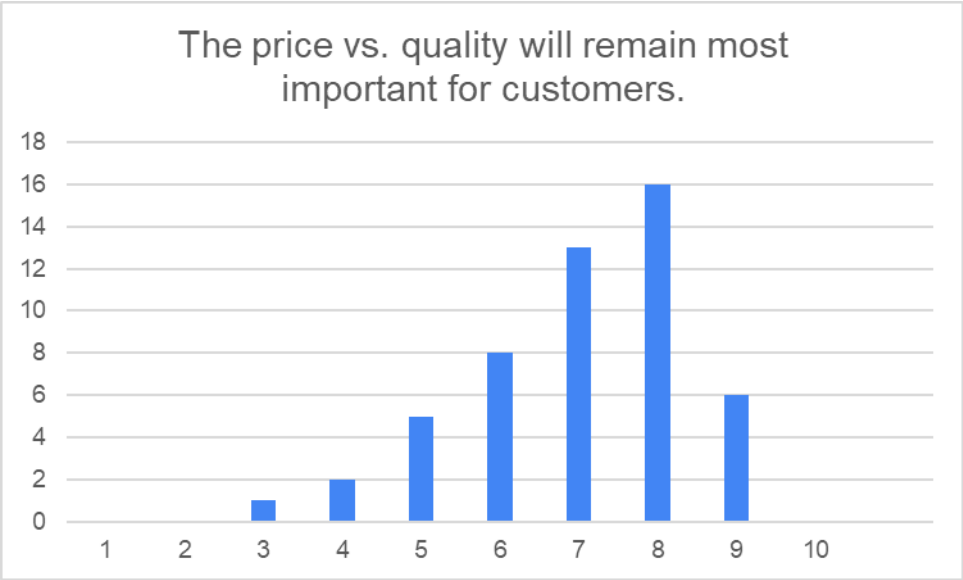

Figure 9. Distribution of answers to the claim that price vs. quality will remain a key issue for customers. 10 = fully agree, 0 = disagree.

Artificial intelligence takes the role of farmers in decision-making. The future farmer will be a system operator

The results for this question of the survey illustrate that although AI is and will be a fundamental technology for precision agriculture services, the role of farmers and agronomists will not be replaced for the decision-making process. On one hand, the use of completely autonomous and automated systems is still in the process of being regulated. In this sense, the European Commission is working on a new regulation that, among other aspects, defines a risk classification schema for AI-based systems. Although initially, agriculture seems to fall within the minimal risk group, we should consider the potential damages that AI systems including actuation and control over fields could cause in case of failure, e.g., environmental contamination with chemical substances, hazards for human health, economical losses. It must be also considered that in the short and medium-term, the most likely hypothesis will be the coexistence and collaboration of autonomous agriculture machinery and human workers and therefore control and decision-making by AI systems should include proper agency and oversight mechanisms.

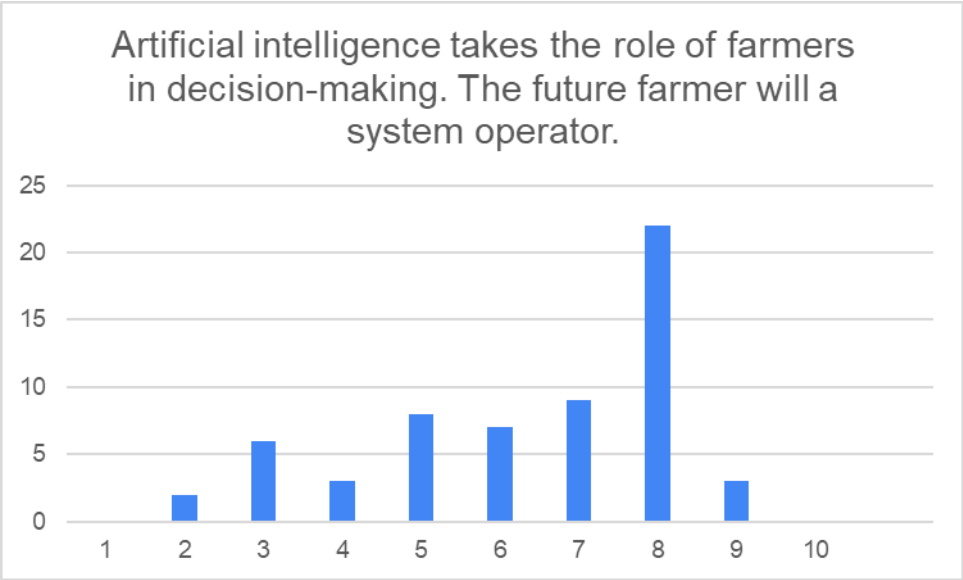

Figure 10. Distribution of answers to the claim that the role of the farmer will change as a system operator due to AI in future. 10 = agree, 0 = disagree.

Finally, there are other aspects that must be furtherly studied before realising a futuristic situation where AI systems completely undertake the role of the farmer. For instance, acceptance by crops' insurance companies that should update their current products and policies.

The main role of robots is the reduction of labour in heavy and dull jobs

Clearly, improving the current labour conditions of farmers is one of the reasons that justify the introduction of robots in the agricultural domain. Nevertheless, the possibilities and benefits for this kind of system go beyond just this mere advantage. Some examples can be already observed in the introduction of driverless tractors since according to some articles net returns are higher and machinery ownership and operating costs are reduced [13]. As the FlexiGroBots project aims to demonstrate through the three pilots, that relying on fleets of heterogenous robots will allow early detection of pests and diseases, application of treatments with high accuracy and lower environmental impact, and obtaining more detailed information about the fields in an affordable manner.

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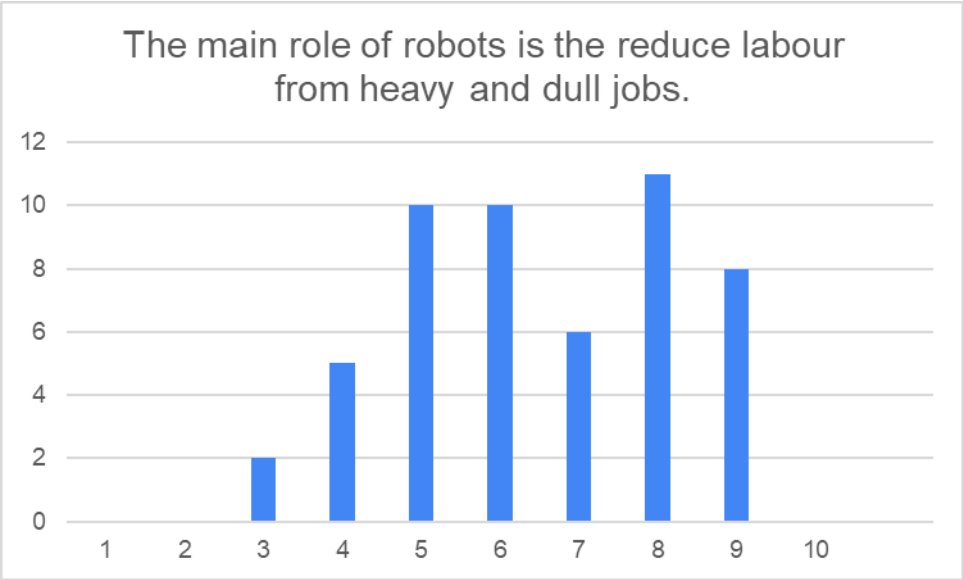

Figure 11. Distribution of answers to the claim that the main role of robots is to reduce dull and hard labour. 10 = agree, 0 = disagree.

Sharing farm data is a big threat to farmers independency

The creation of a trusted ecosystem for sharing data between all the different stakeholders involved in the agricultural domain is being promoted by different companies and research initiatives all over the world. Nevertheless, as it happens in other sectors as well, there may be doubts about the risks that the exchange of valuable information may imply for the farmers [14]. The main concerns are related to the way of controlling the access that third parties have to their sensitive data. This may be the case of competitors that may analyse the data in order to improve their position in the market. In other cases, big digital players will use their position of dominance in order to force small farmers to agree with unfair contracts without the possibility to change to another provider or to repair their machinery. Nevertheless, as has been also the case of other similar surveys and questionnaires [15], most of the participants in the study do not express these fears and they answer that data sharing will not put farmer's independence at risk.

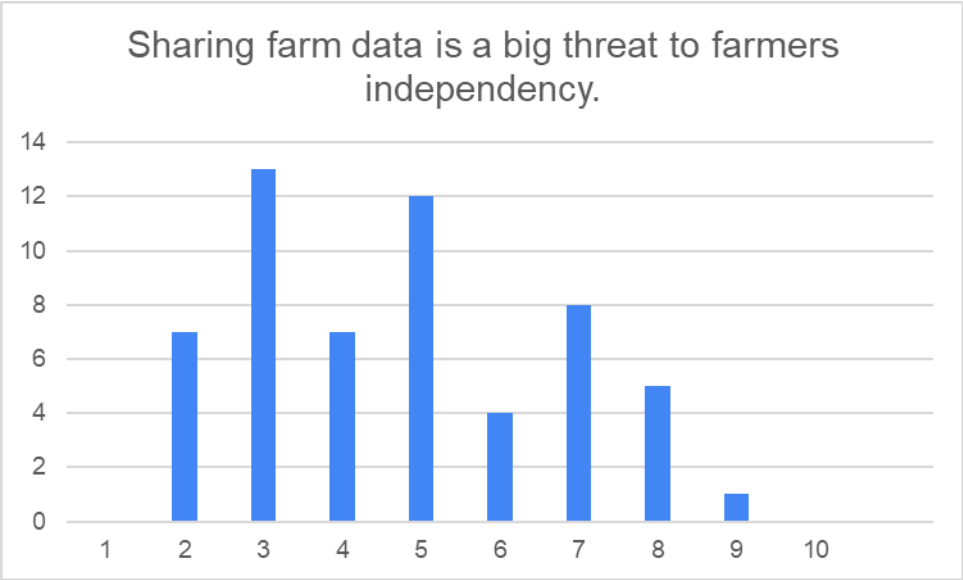

Figure 12. Distribution of answers to the claim that data sharing is a threat to farmers. 10 = agree, 0 = disagree.

3.3 Multi-Robot Fleets

3.3.1 Expectations towards robots

What kind of tasks could you envision for robots to handle? What would be the expected benefits of having robots in these tasks?

The majority of the respondents are of the opinion that robots are of great use especially in hard and repetitive tasks and in slow tasks. Examples are sowing, weeding, pruning, transplanting, fertilising, weeding, monitoring, harvesting, etc. As benefits, in addition, to solve the major problem of the lack of manpower for working in the field, respondents felt that 1) robots could provide a 24-hour service, 2) operators could engage in more intellectual and less physical work, 3) they would suffer fewer injuries (healthier environment for workers), 4) a single operator could take care of larger areas of crop and, in general, 5) all the tasks indicated could be performed faster and more accurately compared to classical methods. Benefits are also identified as 1) the possibility to reduce the carbon footprint by enabling scalable and safe production that can also be brought closer to the urban environment, and 2) the opening to operate in conditions where conventional machinery cannot be used, e.g. on land too wet, too steep, etc.

Furthermore, respondents see robots and automation as the only solution for early detection of pests, weeds, and nutrient and water shortages. Moreover, robots are the only means of applying precision treatments, i.e., treating only the affected part of the crop (weeds, fruits, part of the canopy). The benefits are the reduction of the amount of chemicals used (input saving), consequently reducing the treatment costs as well as reducing pollution that is a consequence of chemicals and ensuring biodiversity.

Some respondents identify the cooperation of robots with operators in agricultural tasks as of great interest and benefit. For example, during harvesting, a robot could be engaged in transporting the harvested produce while the operator is engaged in the actual harvesting.

Regarding robot fleets, respondents identify two types of fleets or operations: 1) the case where all robots perform the same task, but in different areas of the crop and 2) the case where robots are specialized in one type of task and coordinate to perform the whole task in one space, e.g., one robot prepares the soil and right after that another robot does the sowing. In the context of fleets, in addition to the above benefits, there is the chance of using smaller and lighter robots, which reduces soil compaction.

In your opinion, what are the biggest obstacles to integrating robotics into crop management?

Respondents' opinions can be divided into different groups:

- Regulatory barriers - General safety regulations, e.g. legislation limiting the use of autonomous vehicles, now applicable to UAVs but in the future also affecting UGVs.
- Agronomic barriers - Reliable and validated precision farming strategies.
- Psychological barriers - Reluctance on the part of farmers who may distrust AI and robotics. Abuse and misinterpretation of data. How the robot understands that circumstances have changed, how it adapts to the plan, how it recovers and continues to work autonomously. Difficulty in evaluating the robot's performance.
- Physical obstacles - External conditions that reduce the good performance of the sensors, very steep terrain, crops geographically dispersed over a large area, small plots, etc.
- Technological barriers - Lack of availability of technological solutions that effectively fit most field tasks. The low maturity level of available technologies. Lack of robustness of existing technologies. Integration, connectivity, standards and a farmer-friendly interface with the robot need to be achieved.
- Economic barriers - High price of the available technology makes it difficult to transit to another model of work in the field when there are also few tangible benefits. Low cost-benefit ratio. Lack of incentives to acquire and use robotic technologies. Cost of maintenance.
- Knowledge barriers - Lack of technical expertise. Staff involved in fieldwork requires specific training. The average EU farmer is quite old and the uptake of advanced technology is difficult for him/her.

To summarize, technological and economic barriers predominate in the opinions of the respondents, mainly because the benefits of a change in the production model are not clearly demonstrated or widely known.

What kind of farmer training will be necessary for the transition to robotic farming?

Respondents highlight the need for basic training to become familiar with computers, communication networks, human-machine interfaces, planning systems, remote monitoring of robots and robot fleets, and equipment maintenance. It is imperative that all these systems facilitate data exchange and are user-friendly. General awareness of the business benefits of robots in agriculture.

Safety training is needed in a joint robot-operator working environment. How to handle exceptional situations for one robot and for a robot fleet.

Many respondents felt that an extensive number of demonstration days in the field are needed, as the farmer needs to become familiar with the equipment and understand how it is helping him/her. There is a need for a change of mindset and training in the field. It is important that training is more practical than theoretical to overcome the reluctance of some farmers.

Training also needs to focus on AI-based farm management information systems, helping the farmer to understand the meaning of the data collected and how to use them to improve the economic performance and labour costs of his farm.

Group learning sessions are suggested as a good training strategy for farmers.

Will autonomous robotics be able to cope with certain agricultural tasks that require a great deal of power? For example, subsoiling, soil moving with a tiller, manure spreading, etc.

The majority of respondents are optimistic about this issue. They believe that this will be achieved in the long run, although they are aware that it depends to a large extent on the energy source used (diesel, batteries, hydrogen, solar...), which should, in any case, be green. Operator supervision will also be advisable. This is not the biggest challenge of precision farming. In some cases, it may be possible to approach the agricultural task with another type of practice, such as no-tillage cultivation.

The potential barriers that respondents see relate to regulatory issues, i.e. restricting the use of heavy robotic machinery for safety or environmental reasons.

The size of the robot will be an important issue, as well as limitations that appear in northern crops, due to rapidly changing conditions (rain, snow...) and narrowing roads. Even so, in a well-laid outcrop, most respondents think it would be easy to integrate autonomous robots because tractors are already in use and converting them to autonomous vehicles is relatively manageable. It is pointed out that the farmer with the help of an animal (horse, ox …) carried out all field tasks. until a few years ago. This scheme is not far removed from carrying out the tasks with a large number of medium-sized robots.

What solutions can be integrated for the coexistence of large and small autonomous machinery? Can autonomous ground robotics coexist with current machinery?

Most respondents believe that this should be possible as there will at least be a transition period and robots will need to be integrated into farms. They also see the need for robots to have sensors that allow them to reconstruct the state of their environment and for robot behaviour to be clearly defined in the farming environments in which they will be working. They also point to the need for a good Control Centre to manage all the robots, communicating to the operator the location and work path of the robots and the alarms generated by unexpected situations. The challenge is to establish a shared knowledge and to be able to visualise it properly in good graphical interfaces to ensure that farmers are aware of the situation of the machinery in the field. Safety issues are important so all machinery should integrate sensors. Robots will definitely have to be designed to work in the same space with other machines and with operators.

Some respondents believe that it is the current machinery that should be gradually transformed to autonomous.

What kind of tasks are not possible for robots in your opinion and why?

The majority of respondents felt that in theory, a robot could perform any kind of task.

Some respondents felt that robots would not be able to make complex decisions. They should be designed for very specific tasks and should always be supervised, especially in environments where conditions abruptly change. They see greater complexity in multi-tasking and human-robot interaction.

Multiple respondents do not see robots performing tasks: 1) with safety issues (e.g. transport between farms on public roads, the appearance of large stones on frozen ground, or the appearance of fallen trees); 2) tasks that require finesse (e.g. picking berries that are usually hidden by leaves, without damaging the plant or some types of manual pruning that require a lot of expertise); or 3) tasks in crops that are difficult to access (e.g. on mountain slopes).

Other respondents focus on the available technology and do not see robots efficiently performing precision tasks in the short term. Humans are still more efficient and better at handling complex situations. Fruit harvesting, which is now done manually, is still a big challenge for robotics.

3.3.2 Features of robotics systems

The features of robotics systems were studied by asking to describe the importance of 15 system characteristics on a scale from not needed to very important. The question was about system speed and efficiency, quality or results, safety, initial cost, ROI, ease of use, independence in task execution, versatility to execute multiple tasks, capability to interact with other robots or existing farmers infrastructures, adaptability to changing conditions,

ability to collect information or to support real-time execution of a mission, and ability to learn and improve its functionality automatically. The summary of the distribution of replies is given in Figure 13.

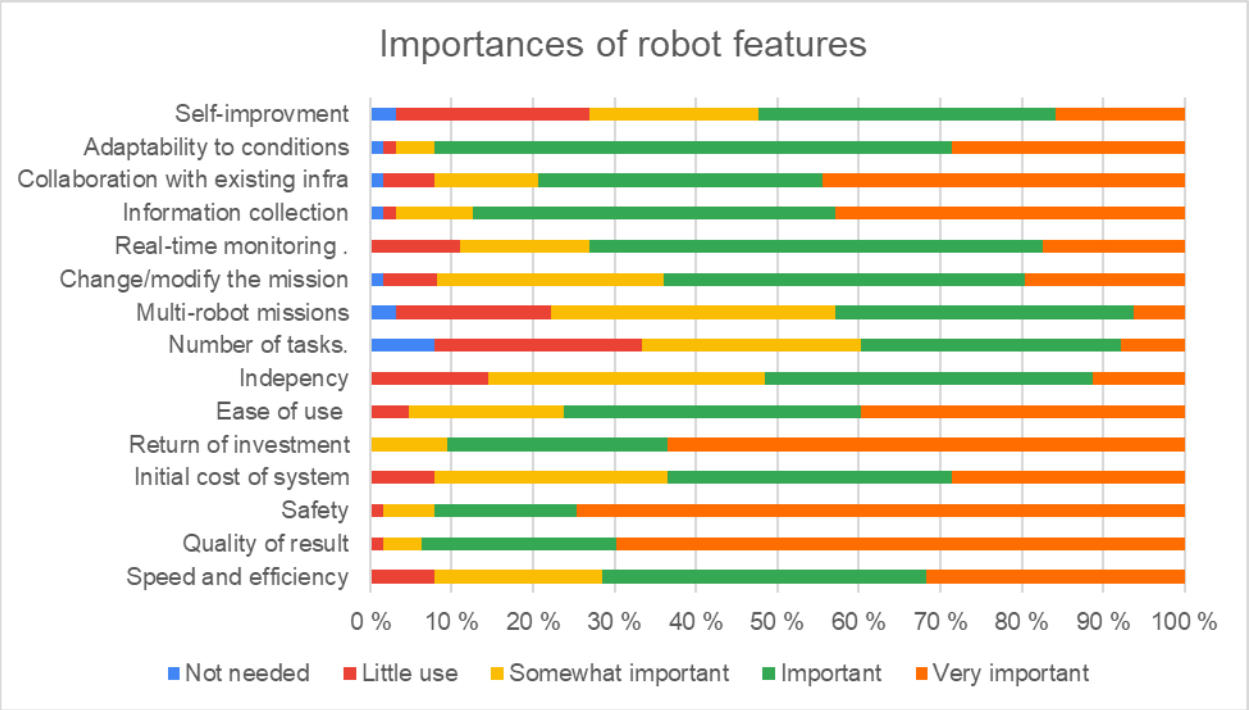

Figure 13. Summary of robot feature importance analyses.

Figure 13 shows clearly that typical efficiency, safety, quality and ROI issues are considered most important, but also the information collection and adaptability to varying conditions got very high scores. The most advanced features such as self-improvement, the capability to execute multiple tasks, and being part of a robot fleet were probably seen as distant and short-term results were considered more important.

3.4 Agriculture Data Space

3.4.1 Data spaces in general

What are the key opportunities of the data economy in the agriculture domain?

The answers provided by stakeholders in this question can be basically divided into three key categories: (1) answers related to opportunities for technologies supporting agriculture, like AI technologies, from the influence of data economy on them (2) answers related to the improvement of agriculture processes' efficiency and (3) answers related to the improved transparency in the agriculture value chain.

More specifically, 46,6 % of the interviewed stakeholders believe that the biggest opportunities of data economy will come from a larger pool of data that will feed advanced

AI-based decision-support systems helping farmers and all other contributors in the value chain to make smarter decisions. Out of this 46,6 %, 33 % expect a huge improvement of current AI approaches due to the availability of more datasets for real-time decisions, detection of crop health and overall improvement of processes through the possibility given by the data economy for more intensive data sharing.

30% of the provided answers were focused on the improvement of efficiency in agricultural production and global chain management. The respondents described the increased efficiency as a way for agriculture companies to deliver more sustainable products and supporting companies to deliver better and more efficient services to them.

Finally, another noteworthy survey result is that 23.3 % of the answers referred to the improvement of the transparency in the agriculture value chain as a result of the extended data sharing between ecosystem players enabled by the data economy. The extended transparency can lead to improved sustainability, better cooperation in the different networks and improved producer-consumer relationship, according to the answers given by stakeholders.

What is preventing data economy and sharing of data in your opinion at the moment?

For this question the respondents concentrated on three main obstacles preventing data sharing from reaching its potential in the agriculture domain: 1) lack of trust, lack of data and technical infrastructure and 3) lack of motivation.

Out of the total respondents 33,3 % thinks that what prevents the stakeholders in the agriculture ecosystem from data sharing is the lack of proper technical infrastructure to support this and lack of datasets covering problems or topics from the farm's operational point of view in a way that creates benefits. The lack of the technical infrastructure is something that this project will focus on, proposing an Agriculture Data Space that will allow all ecosystem players to share their data in a trusted way.

The lack of motivation as a challenge was mentioned in 30 % of the answers. The need for the farmers to be informed about the advantages of data sharing and the development of a more digital-aware mentality is highlighted in the answers of the respondents. In some cases, the lack of motivation has to do also with the ecosystem actors who still think from the perspective of the old business models and are not open to collaborations in the ecosystem. To cover the lack of knowledge and achieve the shift of the mindset, some respondents propose showcasing "best practices" that will give farmers the opportunity to clearly understand their benefits from data sharing.

Finally, according to 43.3 % of the answers, there is a lack of trust in the agriculture domain with ecosystem participants being sceptical about whether the shared data is used as agreed and not against the data providers interests. In many cases, it is unclear who has control over the data collected or produced on farms.

What should be done to enable data exchange in agriculture? How to boost the new services?

Most of the answers (38 %) to this question focus on the knowledge gap that needs to be covered by farmers and other ecosystem actors to be able to clearly see their benefits from sovereign data sharing. According to the respondents, this knowledge gap could be covered with more pilots and real-life examples, demos and training, education programs and workshops where the added value for a variety of stakeholders can be the outcome.

32,2 % of the answers describe the overall infrastructure as the most important enabler for data exchange in agriculture in a sovereign way. More specifically, participants in the questionnaire refer to a platform that will be easy to use and will provide easy access to standardized data sharing allowing participants to have full control over their data. Such a platform could help early adopters to leverage the benefits of sovereign data sharing and convince late adopters to consider using it.

The rest of the answers from the participants referred to policymakers like the ones that could promote data sharing and improve the knowledge of potential stakeholders. Finally, there were a few answers related to the mindset shift required for farmers in order to understand that the added value isn't in the farm itself anymore but lays in the value chain and the data produced daily in the farm.

3.4.2 Data space characteristics

3.4.2.1 With what kind of partners, you would like to exchange data?

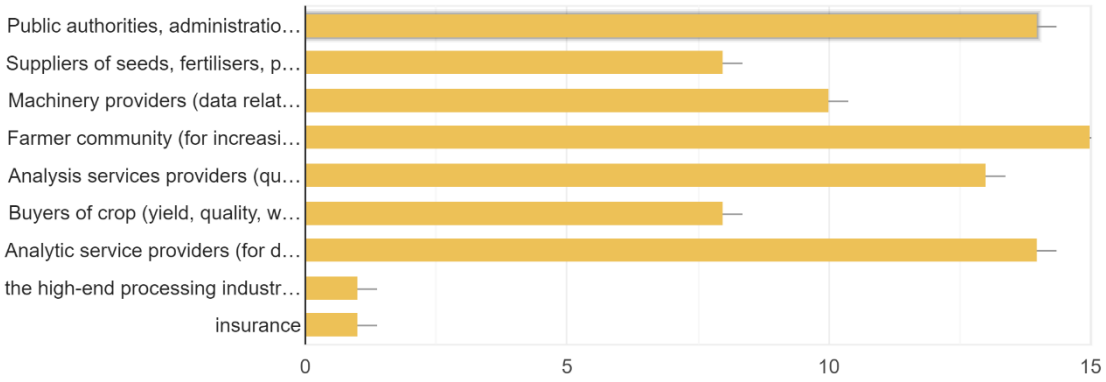

Figure 14. Potential of different types of partners in data sharing.

In this question, the participants show the 3 main groups where they see a clear need for data exchange for farmers in the agriculture domain, namely the overall farmer community, the analytic service providers, and public authorities. Farmers could benefit differently from data exchange without regrets with all these 3 groups.

3.4.2.2 What kind of data related services would you use? Select as many as you like.

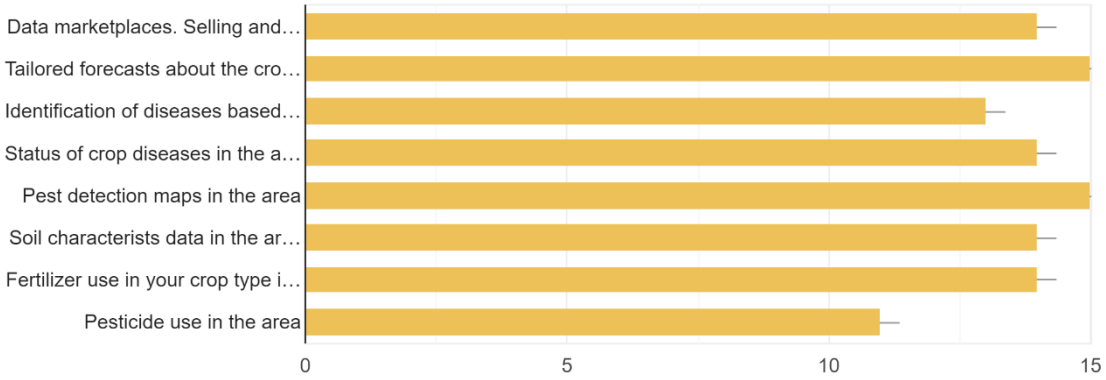

Figure 15. The popularity of data-related services.

The fact that almost all answers on these questions received the same points clearly shows that once in place data related services would be widely used by farmers for improving the overall farming process through tailored forecasts, detection maps etc. In addition, respondents show that they would be willing to buy or sell such data through the appropriate marketplace.

3.4.2.3 Importance of data in data spaces

There were 12 questions in total about the importance of data in data spaces asking the participants to rank the different categories of data from not needed to very important.

The processing and analysis of the answers allow extracting some conclusions:

- The percentage of people that consider all the data-based services as important is for every category the same with this preference to range from 38 % to 46 % in all 12 questions.
- The data-based service that was characterized as the most important from the participants was that of providing weather forecasts of the farming area.
- On the other side, “analyses on the pesticide use in the area” and the “management of your role in the data space” were the items that the participants showed their least interest in. The latter is a clear indication that farmers would be most interested in leveraging the services of data spaces and not actively managing their role in it. This could create a business opportunity for service providers that could offer such management to farming companies.

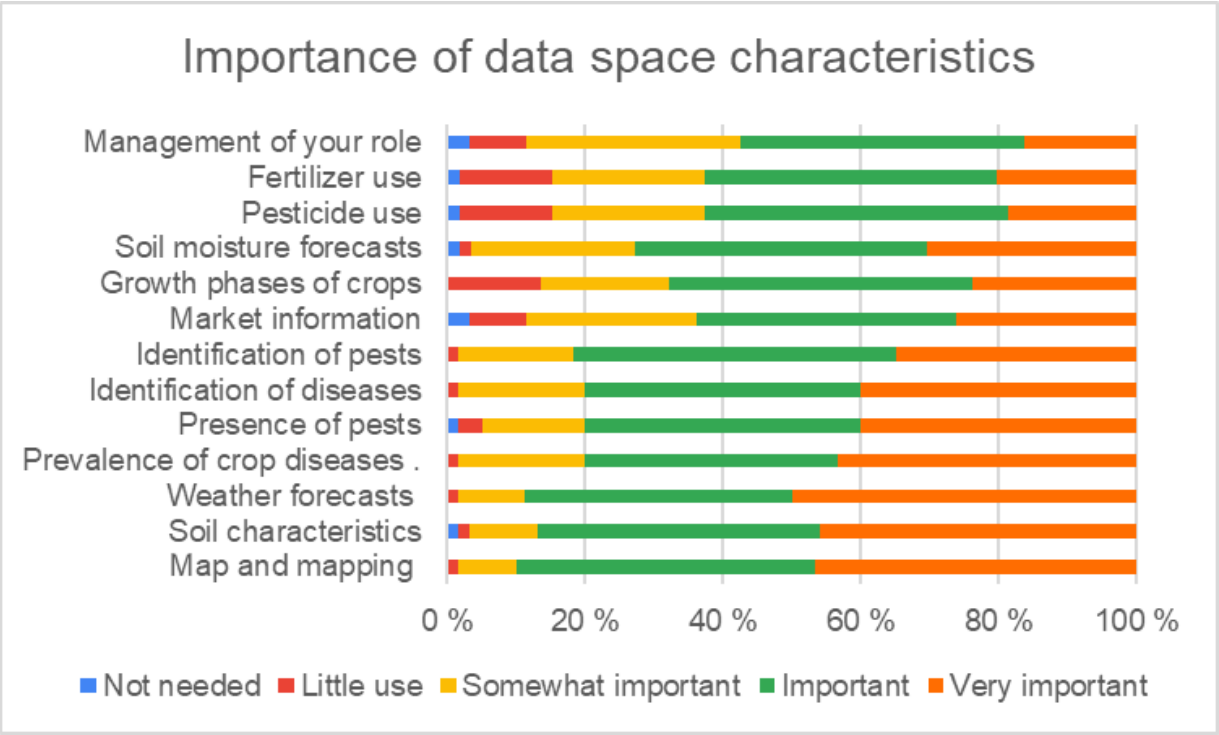

Figure 16. Summary of data space characteristics answers.

3.4.3 Data space properties

In this category of questions, the answers vary significantly resulting in some very interesting conclusions:

- The control of the data is of great importance for the participants of the questionnaire. As agriculture is becoming an attractive source of data coming from many different sources, sovereignty needs to be a day-to-day reality for farmers that want to exploit their agricultural data towards achieving high-performance and sustainable agriculture.
- On the other hand, the location of data and the control of where this is stored doesn't seem to be of great interest to the respondents. This result doesn't come as a surprise as users are mostly interested in data-sharing possibilities and the respective services and are not concerned about whether the necessary data is accessed and shared in the cloud or on-premises infrastructure. Furthermore, the GAIA-X strategy together with the development of IDSA in the last years aims at making the access of data in trusted and collaborative cloud infrastructures under high-security standards a reality for agriculture companies that do not have to care about interoperability and portability of data anymore.
- Another interesting fact is that personal data does not seem to be relevant for agricultural use cases, since none of the respondents characterized the collection or processing of such data as a very important activity.

- Finally, the possibility of selling the data is of some interest for the respondents, but still not of the highest priority. Although a huge amount of data being collected allows big companies in the agriculture sector to enter lucrative business partnerships with companies that depend on such data, farmers have not yet developed the entrepreneurial mindset for digital and data-driven business activities. The FlexiGroBots platform will contribute to helping farmers recognize the value of the data belonging to them and give them the opportunity to monetise the data that might be valuable for others.

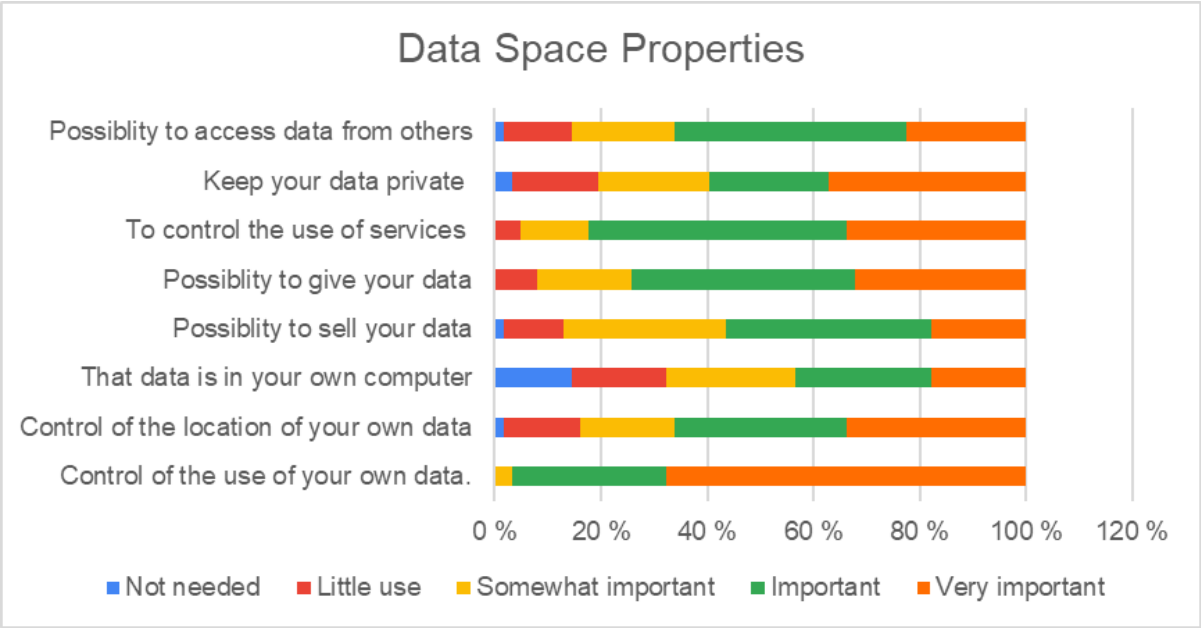

Figure 17. Summary of data space properties analysis.

3.4.4 Use of personal data in use cases

Do you collect or process personal data as part of your use-cases (such as personally identifiable images or names)?

Yes:	17 answers (28 %)
No:	25 answers (42 %)
I am not sure:	18 answers (30 %)

3.5 FlexiGroBots platform

3.5.1 Platform expectations

For this question, a free-form text input was requested from the participants in the survey. In order to summarise the received answers, a word cloud diagram has been generated.

The processing and analysis of the answers allow extracting some clusters:

1. Supporting the improvement of precision agriculture operations with innovative and affordable technologies that can be generalised, integrated, and deployed in the short-term in real-world use-cases.
2. Integration and interoperability with different existing platforms to enable heterogeneous information to be collected from all available sources.
3. Improvements in the operation and management of existing fleets of heterogeneous robots with an affordable cost.
4. The realisation of a secure and sovereign data sharing ecosystem.
5. Open-source and standardised implementation integrating state-of-the-art technologies, which are easy to use and vendor-independent.

Figure 18. Word cloud related to the expectation of the FlexiGroBots platform using the replies to the open questions as source data.

3.5.2 What is important for you in the FlexiGroBots platform?

As can be seen in the figure below, the answers to this question show that the most important feature of the FlexiGroBots platform for the project stakeholders is the possibility to share information thanks to the Data Space functionality. Indeed, it is connected to the following functionalities emphasized by the participants: the need to provide a trusted environment that is interoperable with already existing solutions, independently of the vendor and relying on common data models for the representation of the information. Thus, the platform would unveil the development of services for precision agriculture based on the data that will be available through the interconnection of multiple platforms, devices, and sources. FlexiGroBots stakeholders proposed services for supporting the design and operation of robot fleets in the following level of importance. Finally, it is important to highlight that the possibility to do business with data is not considered a major priority, which is partly in contrast to the prime requirement of being able to share data.

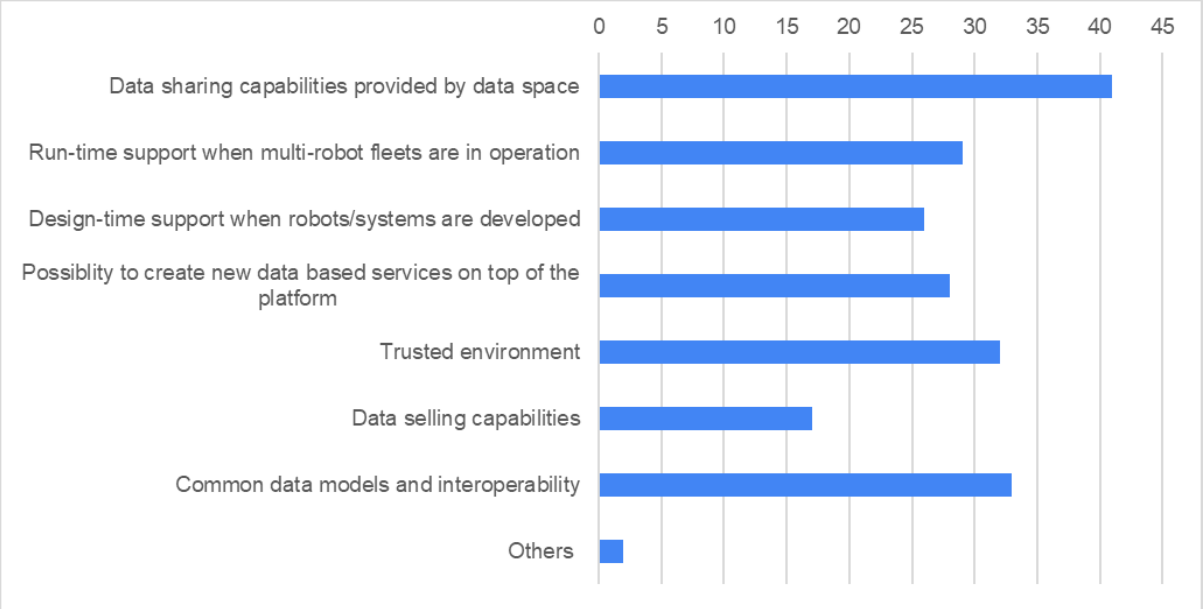

Figure 19. The popularity of different platform services.

3.5.3 FlexiGroBots platform services

With respect to the services initially proposed by the FlexiGroBots platform, the answer identifies three main priorities:

1. **AI service maintenance. Re-training of AI services. Update capabilities.**
    - The AI services offered by the platform should be able to be dynamically retrained with fresh and updated datasets, when performance and accuracy are not maintained (i.e., domain shift issues). This functionality will guarantee generalization and seamless adaptation of the services to new use-cases.
2. **AI services (for example detection, identification of pests and diseases).**

- The portfolio of common AI-based services offered by the platform will be the key component to help farmers to improve their current operations and decision-making processes. For that reason, they have been marked among the critical services to be delivered.

3. **Geospatial services (augmented) maps.**
    - Geographic information systems and satellite images are normally used for farmers and agronomists to monitor and analyse the status of their crops. While vegetation indices maps (e.g., Normalised Difference Vegetation Index or NDVI) have become very common during the last years, integration of important variables and parameters must be done to support more advanced precision farming practices.

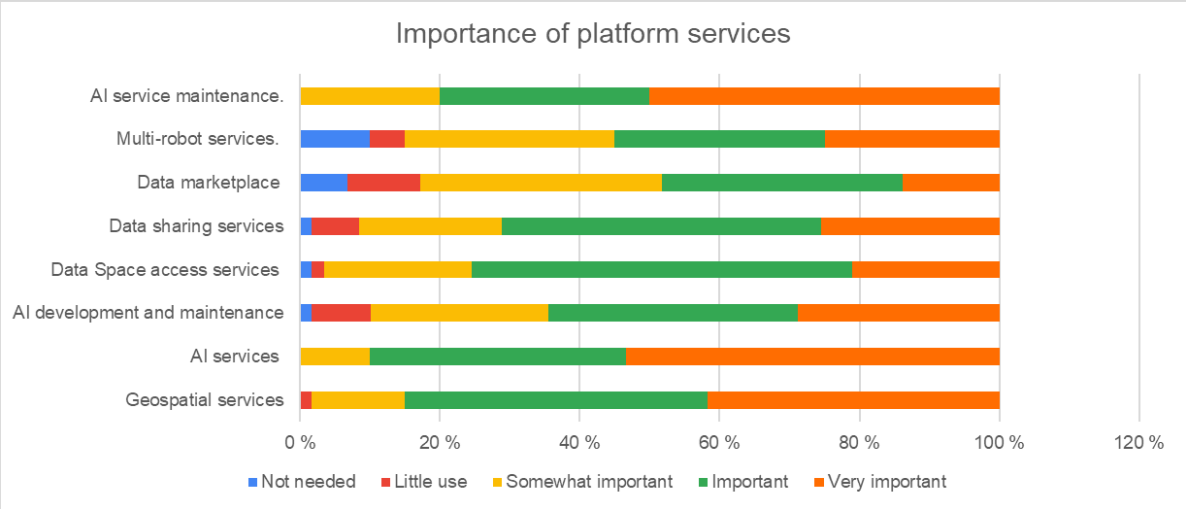

Figure 20. Summary of importance of platform services.

4 Discussion and conclusions

This document presents the stakeholder analysis results from FlexiGroBots Task 2.1. The stakeholder analysis was done as a web survey that was sent to selected stakeholders by email. The questionnaire was implemented through Google Forms. The objective of the survey was to collect information from stakeholders about their opinions and priorities related to the FlexiGroBots project and its planned results on AI, versatile robots, multi-robot missions, and data sharing in the agricultural domain. The project got more than 60 replies that presented the various type of stakeholders including researchers, AI and service developers, and farmers.

When analysing the answers, it must be noted that the number of research-oriented people was high as the questionnaire was sent out to project partners and their acquaintances. The replies to open questions proved that the end-user aspect is visible in the results.

When we summarise the key findings, we end up with the following list:

- In the AI section, there was a strong agreement on the following topics: Precision farming, data collection and transparency. Robotics and AI were considered natural evolutionary steps in agriculture. Willingness to adopt such new technologies seems obvious.
- In the multi-robot section, it was visible that the agriculture tasks and environments are very diverse. Robots are considered a necessity for implementing precision farming. Robots can make new environments feasible for food production. Obstacles are typical to new technology such as costs and complexity. The solution proposed was training and the support of evolutionary development.
- The value of data was well recognised. There is a willingness to create, sell, and use data and related services. The trustworthiness of data infrastructure is understood but it should be provided by someone else.
- In the Platform section, the planned AI and data space services were considered most important. The focus should be on services that create direct benefits to farmers. It was also very clear that security and trustworthiness are very much needed in the solution.

It was surprising that even though most replies came from research people, the robot fleet operations were not on the top of the list. There was even some scepticism expressed. Robot fleets were said to open new possibilities and potential benefits, but there was a lack of trust in the maturity of the technology and its readiness. However, the ambition level of the project is high enough for innovation action.

Implementation of the questionnaire through Google Forms was a relatively simple process. The distribution using email lists was also simple. The problem with Google Forms is that it only has a limited set of question types and it does not support the analysis of open questions very well. Already during the design of the form, it was clear that a not very in-depth analysis

will not be possible, and that the number of open questions must be kept low. In this kind of survey, face-to-face interviews with experts would also improve the completeness of the results. That would have required another type of resources from the project. It must also be noted that ethics type of issues was missing from this task as they will be covered in Task 2.4.

The initial recommendation for the platform to be derived from the results is that we should continue as planned. There were no major reasons to modify the plan. Aspects, such as basic robot operations and the potential of the Data Space in the development and maintenance of AI services, could be emphasised more. The robots capable of multiple tasks and using robot fleets seemed to be more futuristic ideas. Their value was recognised, but there were doubts whether they could be realistic goals for now. Clearly, they should be kept as platform capabilities, but maybe the expectation level should be lower.

Conclusions and future steps

The initial objectives of the survey were to get a broader view of the project objectives and to understand better how the project should focus its resources on the FlexiGroBots platform development. These objectives were mostly achieved. The survey confirmed that the ideas behind the project are correct. The intended content of the platform is viable.

Platform definition and specification will continue in Task 2.2. In many ways, this survey stayed at a rather generic level. It did not go into details of AI services or into the details of how robot fleets should be implemented. These aspects need further study.

The data space concept was shown to be important. The more detailed study of its potential needs understanding of how different activities in the project use cases are related to each other as business entities. Therefore, the work in WP7 in its exploitation and business model tasks should be connected to platform definition and to the results of this survey. The business models and value co-creation models could have an impact on these results.

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Annex 1 – FlexiGroBots Stakeholders Questions

FlexiGroBots Stakeholder Questions

This is questionaire for FlexiGroBots stakeholders for better understanding the expectations and requirements to be set for FlexiGroBots platform and systems.

The questionaire consists of three main parts. First deals with multi-robot fleets and their usage. Second deals with data and service exchange between different organisations in agriculture and the new data space concept supporting it. Third part focuses on FlexiGroBots platform and your expections on it.

Answers are anonomous but we want to have some background information for result analysis purposes.

1. What is your role in agriculture?

Merkitse vain yksi soikio.

- ◯ Farmer or farming expert
- ◯ Automation expert
- ◯ AI or platform developer
- ◯ Machine or SW provider
- ◯ Research institution
- ◯ Robotic system provider
- ◯ System integrator/operator
- ◯ Advisory/support/service organisation (DIH, etc.)
- ◯ Muu: _____

2. Where did you got the link to this survey?

Merkitse vain yksi soikio.

- ◯ E-mail
- ◯ Twitter
- ◯ LinkedIn
- ◯ Project webpage

3. When do you think multi-robot operations are a common practice in agriculture

Merkitse vain yksi soikio.

- ◯ They are already now
- ◯ 2022
- ◯ 2023
- ◯ 2024
- ◯ 2025
- ◯ 2027
- ◯ 2030
- ◯ Later
- ◯ No idea

Opinions related to AI, data, and robots

Following questions are claims into which we would like you to answer, in what extent you agree with them or not.

4. Most of the physical work currently done in agriculture will be done using robots.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

5. Data collected from the farm will play important role in the value of the final food product.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

6. Data collected from the farm can be sold as a separate asset.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

7. Precision farming will be a dominant approach in food production.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

8. Food production needs almost real-time data from the conditions of crop diseases or pests in the surrounding area.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

9. Transparency of food production will be very important.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

10. The price vs. quality will remain most important for customers.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

11. Artificial intelligence takes the role of farmers in decision-making. The future farmer will a system operator.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

12. The main role of robots is the reduce labour from heavy and dull jobs.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

13. Sharing farm data is a big threat to farmers independency.

Merkitse vain yksi soikio.

	1	2	3	4	5	6	7	8	9	10	
Do not agree	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Agree totally

Multi-Robot Fleets

This section deals with multi-robot fleets and your expections and concerns towards them.

14. What kind of tasks you could envision for robots to handle? What would be the expected benefits of having robots in these tasks?

15. In your opinion, what are the biggest obstacles for integrating robotics into crop management?

16. What kind of farmer training will be necessary for the transition to robotic farming?

17. Will autonomous robotics be able to cope with certain agricultural tasks that require a great deal of power? For example, subsoiling, soil moving with a tiller, manure spreading (manure) .... etc.

18. What solutions can be integrated for the coexistence of large and small autonomous machinery? Can autonomous ground robotics coexist with current machinery?

19. What kind of tasks are not possible for robots in your opinion and why?

Features of robotics systems

How important are the following features of robotic systems in you opinion?

20. Speed and efficiency when performing the tasks

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

21. Quality of result of tasks

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

22. Safety

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

23. Initial cost of system

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

24. Return of investment (cost vs. benefit)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

25. Ease of use for a farmer.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

26. How indepently the robots can perform their tasks.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

27. Number of tasks each robot is capable of doing.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

28. Ability to plan and execute multi-robot missions

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

29. Ability to change/modify the mission flexibly.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

30. Real-time monitoring of robot fleet mission execution.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

31. Capacity to collect information from the crops

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

32. Integration and coexistence with other systems

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

33. Adaptability to dynamic and changing conditions

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

34. Self-improving functionalities

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

35. Was there something missing in previous question that is important to you? What and why?

Agriculture Data Space

Agriculture data space is a concept that is defined as data and services that can used for creating new, better services for stakeholders in agriculture domain. The key implementation aspects of agriculture data space are the interoperability of data, means to create trusted networks of services, an agreement to follow common policies and rules in the handling of the data, and respecting of data ownership and soverignty.

The data in the data space is located at owner's site. It is exchanged only with owners permissions. Data Space enables various kinds of business and collaboration networks with their own data and practices.

36. With what kind of partners you would like to exchange data?

Valitse kaikki sopivat vaihtoehdot.

- [ ] Public authorities, administration (data related to your actions in the farm)
- [ ] Suppliers of seeds, fertilisers, pesticides (data related to the need of those products)
- [ ] Machinery providers (data related to the use of machines)
- [ ] Farmer community (for increasing common knowledge or awareness)
- [ ] Analysis services providers (quality, yield, etc. detailed data directly from the farm)
- [ ] Buyers of crop (yield, quality, ways how crop is produced, CO2, pesticide use, etc.)
- [ ] Analytic service providers (for developing more advanced services)
- [ ] Muu: _____

37. If you think of the list above, what are they key opportunities of digitalisation and data economy in agriculture domain today?

_____

_____

_____

_____

_____

38. If you think of the list above, what is preventing data economy and sharing of data in your opinion at the moment?

_____

_____

_____

_____

_____

39. What kind of data related services would you use? Select as many as you like.

Valitse kaikki sopivat vaihtoehdot.

- [ ] Data marketplaces. Selling and buying data for any use.
- [ ] Tailored forecasts about the crop production and quality of the area
- [ ] Identification of diseases based on satellite or drone images
- [ ] Status of crop diseases in the area
- [ ] Pest detection maps in the area
- [ ] Soil characterists data in the area, e.g. soil characteristics maps (e.g. moisture)
- [ ] Fertilizer use in your crop type in the current year in your area
- [ ] Pesticide use in the area

40. Was there other types of services that you would like to have? What?

Data space characteristics

Give your opinion about the importances of the following data space services.

41. Map and mapping services, visualisation of data

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not need	◯	◯	◯	◯	◯	Very important

42. Provoding weather forecasts of your area

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

43. Showing the soil characteristics (moisture, etc.)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

44. Creating soil moisture forecasts for fields

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

45. Identification of diseases from images (drone)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

46. Prevalence of crop diseases in the area.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

47. Identification of pests from drone images: Locations of pests.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

48. Presence of pests in the area

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

49. Analyses on the pesticide use in the area

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

50. Growth phases of crops in the area.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

51. Summaries and analyses of the fertilizer use in the area

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

52. Up to date market information (prices, demand)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

53. Management of your role in the data space

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

Data space properties

Give your opinion about the importances of the following data space properties. What features should the data space implement.

54. Control of the use of your own data. Do you want to control the access, use, or time of use of your data when given access by other.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Vry important

55. Control of the location of your own data

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

56. That data is in your own computer or in your facilities

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

57. Possiblity to sell your data for developement of services or as an information to others.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

58. Possiblity to give your data and to have improved services for your own use.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

59. To control the use of services that use your data

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

60. Keep your data private

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

61. Possiblity to access data from other farmers (when they give permission)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

62. Does personal data or collection of personal data any role in your operations?

Merkitse vain yksi soikio.

- ◯ Yes
- ◯ No
- ◯ I am not sure

Flexigrobots platform

FlexiGroBots project is developing a platform that enables the Agriculture data space and the use of multi-robot fleets in various farming tasks.

63. What do you expect from FlexiGroBots platfrom and services?

64. What is important for you in FlexiGroBots platform? Pick as many alternative you like.

Valitse kaikki sopivat vaihtoehdot.

- ☐ Run-time support when multi-robot fleets are in operation
- ☐ Design-time support when robots/systems are developed
- ☐ Possiblity to create new data based services on top of the platform
- ☐ Data selling capabilities
- ☐ Common data models and interoperability
- ☐ Trusted environment

Muu: ☐ _____

FlexiGroBots platform services

Here we have a list of services offered by FlexiGroBots platform. We would like to know your opinion of their importance to you.

65. Geospatial services (augmented maps)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

66. AI services (for example detection, identification of pests and diseases)

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

67. AI service maintenance. Re-training of AI services. Update capability.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

68. AI developement services. For manufacturers to integrate AI to robots and systems.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

69. Data Space access services for connecting systems to agriculture data spaces and for controlling of the use of data.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

70. Data sharing services within the data space.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

71. Data marketplace as a market place of your own data or for accessing other available data.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

72. Multi-robot mission planning, execution and monitoring services.

Merkitse vain yksi soikio.

	1	2	3	4	5	
Not needed	◯	◯	◯	◯	◯	Very important

Thank you very much!