

PR4 Identification of the skills required on the labor market in the next 15 years



LATEST

Local-focused AgTech Education
for Successful Ag Transitions

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Task 4.1 Current situation analysis

Definitions and abbreviations used in the report

AgTech: agricultural technologies; the modern definition of AgTech is the application of artificial intelligence with a focus on data-driven decision-making, and the progression from "farming" to "smart farming". The objective of AgTech is to implement smart solutions ensuring the sustainability of production in the field of agriculture within the framework of the food security strategy of the United Nations sustainable development program (Spanaki et al., 2022).

PA: precision agriculture

LATEST: Local-focused AgTech Education for Successful Ag Transitions, an Erasmus+ project (2021-2024). LATEST has five consortium partners: University of Hohenheim, Germany; UniLaSalle, France; BOKU, Austria; University of Udine, Italy; Harper Adam's University, UK. Project website: <https://latest-project.eu/>

Survey A: Farmers, landowners, contractors, producer's associations.

Survey B: Dealers and manufacturers.

Survey C-D: Data providers, Technology providers.

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1. Introduction

European educational initiatives aimed at improving farmers' digital skills are dispersed and fragmented, challenging the agricultural transition towards sustainability. The aim of the LATEST project is to identify possible gaps in training offer and to conceptualize a comprehensive master program at EQF level 7 to foster the use of AgTech for a sustainable agricultural transition. To achieve these goals, a number of project tasks has been outlined. Among them, PR4 is devoted to identify the skills required by labour market for AgTech in the next 15 years. PR4 is organised in two different parts: PR4.1 focuses on the identification of the current skills required by labour market and PR4.2 is projected over the next 15 years.

This report includes the findings of PR4.1 obtained through a literature review conducted in 2022-2023 and a survey campaign conducted in each partner country from March 2023 to October 2023. The literature review allowed us to identify the main skills required for PA that were then used as input in the survey.

Project partners discussed and validated the method proposed by UNIUD during the second transnational project meeting held at the University of Udine in December 2022. The results of the literature review and of the surveys were presented during the third transnational project meeting in Wien in November 2023. The results of the survey were presented as an abstract to the 15th IFSA (International Farming System Association) conference that will take place in Trapani, Italy in July 2024 that was accepted as an oral communication.

2. Materials and Methods

2.1 Literature review

The goal of this literature review was to gain insights on the scientific literature related to the adoption of precision agriculture (PA) and the skills needed for that. For this reason, we used the Scopus database as source of a corpus of scientific papers on this topic. The papers were selected according to the PRISMA methodology for systematic literature review. A first classification of the selected papers based on the abstract was done using a grid (Fig. 1), from that, we finally selected the papers included in the analysis and a full-text analysis was performed. The final search terms on the Scopus database derived from different iterations and was the following: TITLE-ABS-KEYWORDS (skill* OR train* OR knowledge) AND (("precision agr*" OR "precision farm*") AND ("smart agr*" OR "smart farm*")). We selected in the corpus articles and reviews from 2012 until 2023, in English to ensure our capacity to analyse them. We screen analysed the title and abstracts of the papers selecting those that were dealing with education and training in precision agriculture. Starting from them, in a snowball

approach, we selected also other relevant publications quoted by the authors. Finally, a list of 12 papers were analysed in the full text.

2.2 Survey

Based on the results of the literature review we identified the most important skills to be considered in the survey. Moreover, according to Rizzo et al. (2021) we identified four different stakeholders having an important role in the precision agriculture supply chain:

- 1) Farmers, landowners, contractors, producer's associations.
- 2) Dealers and manufacturers.
- 3) Data providers.
- 4) Technology providers.

For each stakeholder a specific survey was prepared and administered using Google Forms (Annex 1). The survey took place between May 2023 and September 2023 in the countries of each partner of the LATEST project (Italy, France, UK, Austria and Germany) thus including some of the most important agricultural EU countries. To Partners were asked to provide minimum of ten survey for each partner and at least one for each stakeholder and the survey was submitted in the local language.

Table 1 : Survey distribution per Stakeholder and Partner. *Survey A: farmers, contractors, landowners; **Survey B: dealers and manufacturers; ***Survey C: data providers; ****Survey D: technology developers.

	ITALY	AUSTRIA	FRANCE	GERMANY	ENGLAND	TOTAL
	Uniid	BOKU	La Salle	Hohenheim	Harper Adams	Total per stakeholder
Survey A *	8	0	2	3	9	22
Survey B**	2	1	6	14	6	29
Survey C***	2	0	0	2	3	7
Survey D****	1	1	1	4	3	10
Total per partner	13	2	9	23	22	68

For some partners this goal was difficult to reach, especially for the survey C and D: Data providers and Technology developer. For this reason, we decided to analyse the results of the two surveys together. Each surveys was composed of three parts containing both structured and semi-structured questions:

the first one related to some general characteristics of the surveyed actor (age, gender, level of education...), a second about his/her professional practices (differentiated according to the stakeholders' type) and a last one about his/her experience with precision agriculture and the skills required. The Partners sent the survey using a list of their own contacts or a snowball method starting from their contacts. At the end of the survey, the total amount of surveys obtained was 68 (Table 1).

2.3 Data analysis

For the data analysis, we both performed quantitative statistics (descriptive statistics and differences among groups) using the RealStatistics tool and textual analysis on the comment parts using ChatGPT and TagGrowd to find the most common discourses in the semi-structured questions. The word cloud considered only 20 words with a frequency of minimum 2 and the words Precision Agriculture and Farmers were not considered.

3 Results

3.1 Literature review

The literature review allowed us to identify the most common skills for precision agriculture and digital farming: agronomical, Data Analysis and ICT, Business and Management, Engineering and Technology (Table 2). Other less frequent skills are related to the Environment and Local Ecosystem knowledge, Laws and Norms. In some cases, the authors detailed the different sub-areas, e.g. for data analysis they separated in data processing, data analysis and data interpretation.

Table 2 : Main skills needed for Precisions Agriculture retrieved in a literature review.

Authors	Topic	Agronomical skills	Data Analysis skills	Other skills
Kitchen et al., 2002	Educational needs for new teaching programmes	Agronomical	Data analysis The correct use of GIS/ Spatial data analysis, IT	-
Bullok et al., 2007	New practices in agricultural training	Agronomical	Data Interpretation	Engineering, Economics
Michailidis et al., 2019	Training needs assessment in PA	Agronomical	-	Environmental Technical Managerial
Baptita et al., 2021	Overcoming limitation of the PA	Agronomical	Information and Communication technology	Environmental Management
Bournaris et al., 2022	Skills needed in the future PA training	-	-	Technological expertise Legislative expertise Local community leadership Business management skills Innovation management Marketing Sustainability

				Local ecosystem
Puntel et al, 2023	The new skills needed in PA	Agronomical	Data processing Data analysis Data interpretation	Economics Engineering
Department State Growth Tanzania, 2022	Maintain and attract new staff in agriculture	Agronomical: knowledge or understanding of the relevant on-farm technologies	IT	
Ritz et al., 2022	Qualitative analysis of the French educational system in Agro-machinery	Agronomical	Digital skills	Engineering and Mechanics in agro-machinery
Manning et al., 2022	Use of AgTech in classrooms		Digital skills Data analysis	Critical thinking

3.2 Survey

3.2.1 The respondents

The analysis highlights that the survey A respondents (farmers and contract workers) are younger than other categories of stakeholders, with an average of 40 years old, the oldest being on average the Technology developers and Data providers (Table 3). The Kruskal Wallis test highlighted that there is not a significant difference between the ages of three stakeholders' groups. Data providers and Technology developers with Dealers and Manufacturers have the higher level of education with 38%-39% of PhD degree, while the majority of farmers, 55%, have a Bachelor degree (Figure 1). Each stakeholder's category is dominated by male gender with a maximum value in survey A (90% male) and a minimum in survey B (84% male).

Table 3 : Age and gender of the respondents

	Average Age	Gender
Survey A	40 years	90.0 %male 10.0 %female
Survey B	45 years	84.0 % male 16.0 % female
Survey C-D	48 years	87.5%male 12.5% female

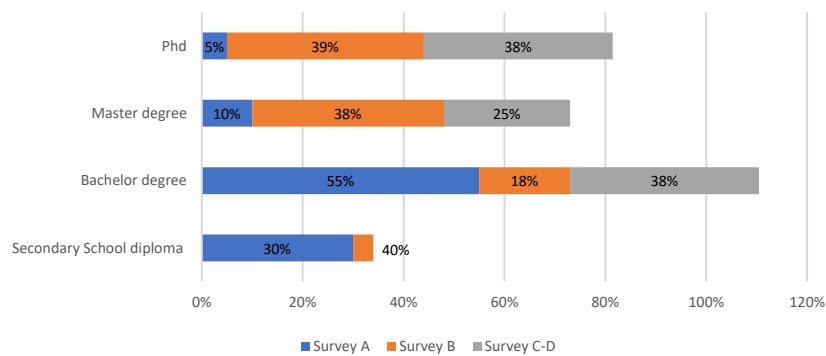


Figure 1: Degree of education of the respondents

The stakeholders involved in survey A who work in a farm are 57%, and 68% of them work as a farm manager and 22% as a farm worker. The high percentage of the stakeholder of survey B, C, D are manager or employee in their company with 84% of dealers and manufacturers and 63% of technology developers and data providers (Table 4).

Table 4 : Role within the farm or the company

	Role within the company	Average value
Survey A (n=22)	Farmer	68%
	Employee	5%
	Farm worker	22%
	Temporay worker	5%
Survey B (n=29)	Entrepreneur	3%
	Manager/employee	84%
	Sales clerk	13%
Survey C-D (n= 17)	Entrepreneur	25%
	Manager/employee	62%
	Other	13%

Regarding the main area of activity, 52% of the farmers tick the box of cereals, 20% of vegetables including tubers, 16% of tree crops (including fruit, olive, grapevines) and 12% Livestock breeding (particularly pig fattening). Regarding the farm size, the majority (75%) of the respondents declared more than 100 ha, while the average farm size was 88 ha.

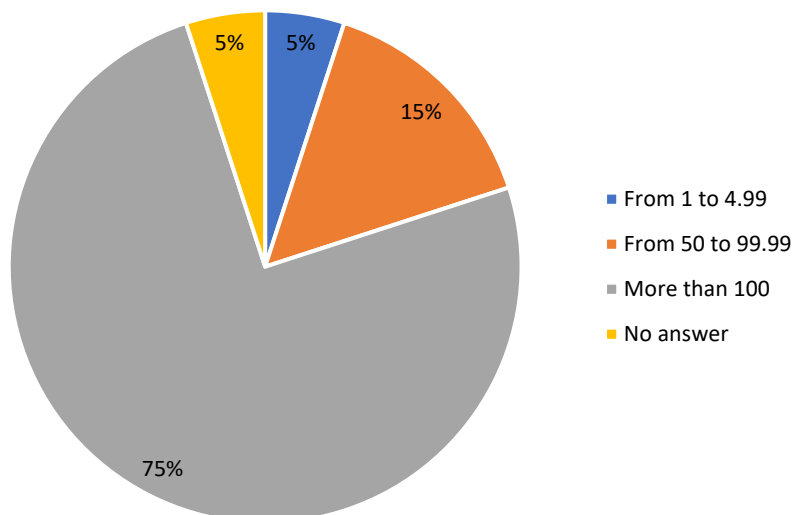


Fig. 2 Extension of cultivated area (Survey A).

3.2.2 Use of technology

Regarding the use of technology in farming, the 60% of respondents declared to use a software for their job. The more used software are Field View and My John Deer respectively used by 20% of the respondents, X Farm used by 15% of the respondents, Trimble and FendtONE used respectively by 5% of the respondents. Guidance is the more used technology used by 46% of the respondents, followed by Recording 33% and Variable Rate by 21% (Figure 3).

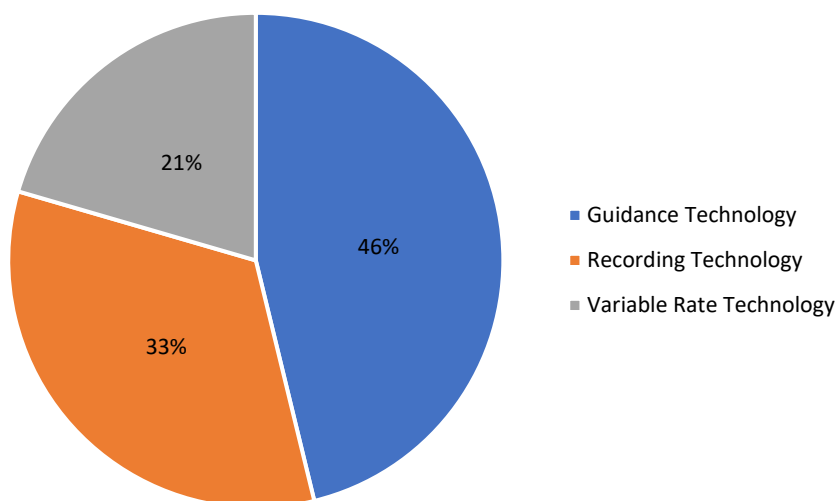


Fig 3 Type of technology used by farmers.

Data used by farmers are especially provided by agricultural machinery (39%) and remote sensing (32%). Drones appear to be used by less farmers (4%) as shown in Figure 4.

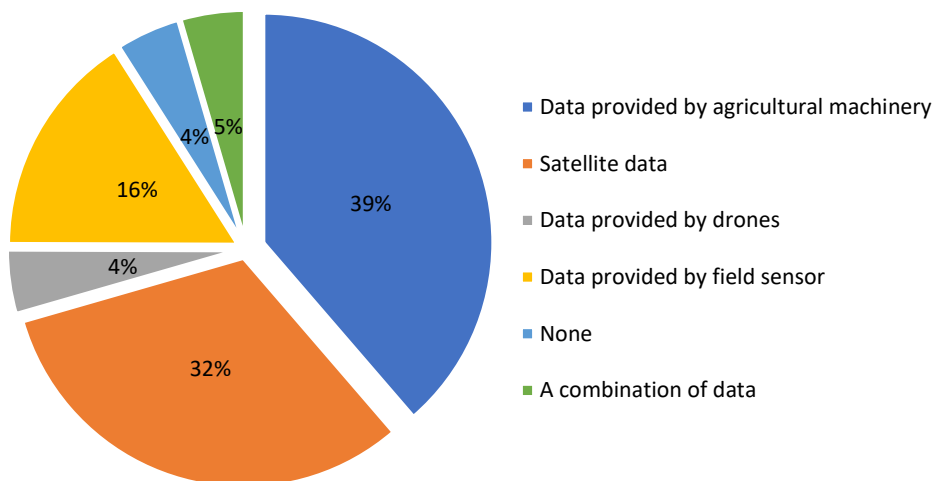


Fig. 4 Data used by farmers

The data are used in different activities particularly in sowing, fertilization and pesticide application, however all fields of the farm management are concerned (Figure 5).

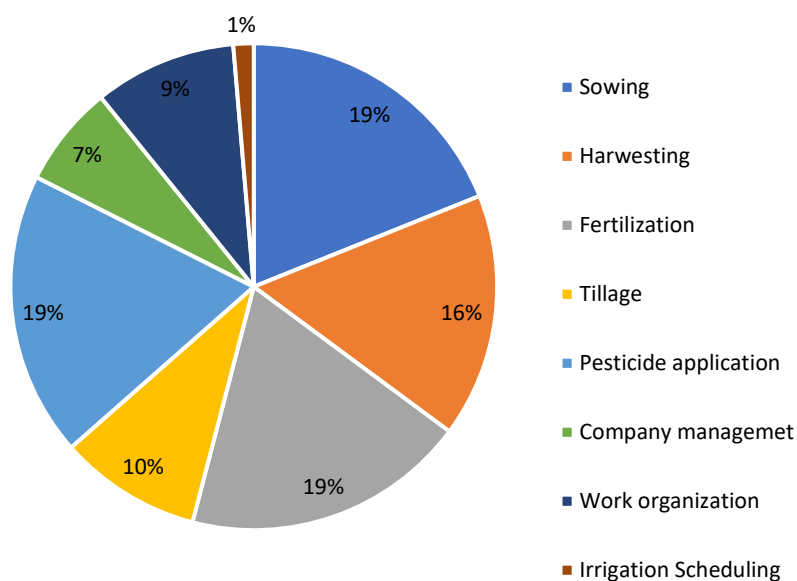


Fig.5 Farming activities and data used

To the question “On a scale from 1 (none) to 10 (for all activities in the field) select the amount of technology at your disposal for precision agriculture that you use”, only one respondent ticks the box 10. The average is 5.35 with the standard deviation of 2.74

In the case of data providers, agronomy recommendation 26%, and data provided by sensors 22% are the most products provided (Figure 6). Software is the most provided technology by technology developers (Figure 7).

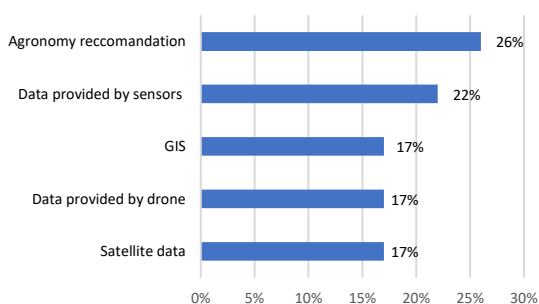


Fig. 6 Data provided.

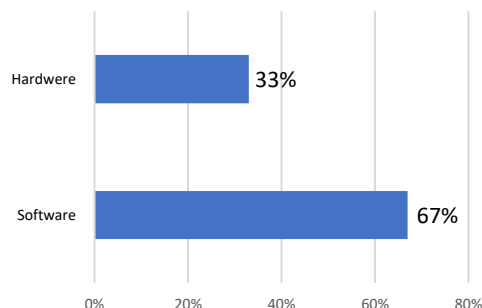


Fig. 7 Technology developed.

From the side of dealers, manufacturers, technology developers and data providers their products are used especially for sowing, harvesting, tillage and pesticide applications (Figure 8) even though all the different sides of farm management are considered. Figure 8 also shows that there are few differences in the areas of application for survey B and Survey C-D, except for work organization that is more considered by Survey C-D.

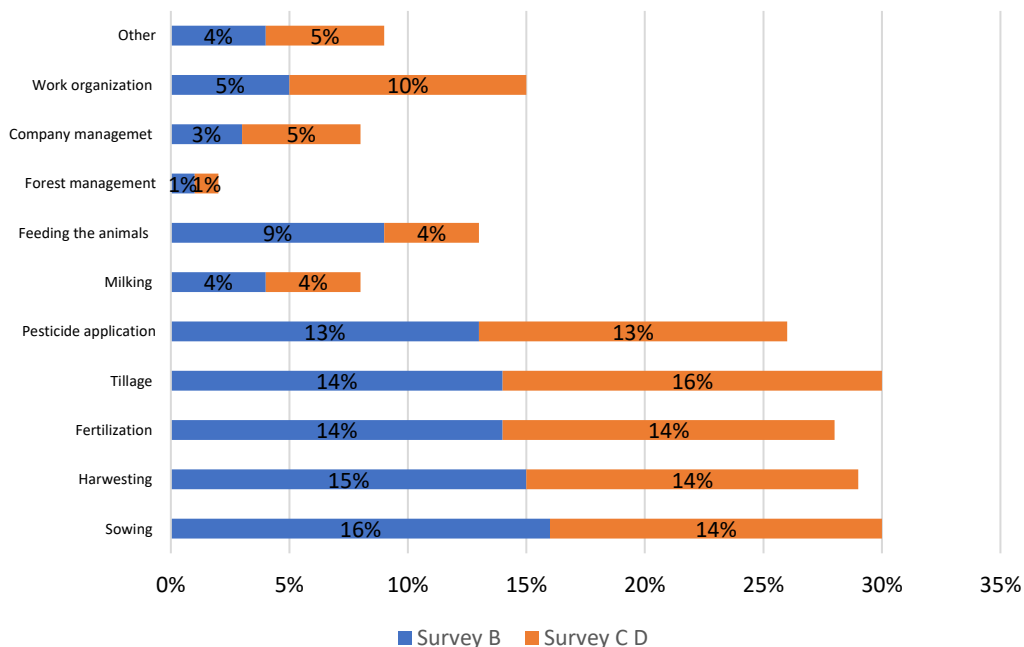


Fig. 8 Activities for which data and technology are required.

3.2.3 Training on the use of technology for PA

Only the 35% of farmers received a specific training for the correct use of the technology they are using (Figure 9), 71% of them from the company that provides the software (Figure 10). Of these 71%, 43% declared that the course was not useful for using the technology (Figure 11). These results highlight the lack in specific training for the use of new technology by farmers.

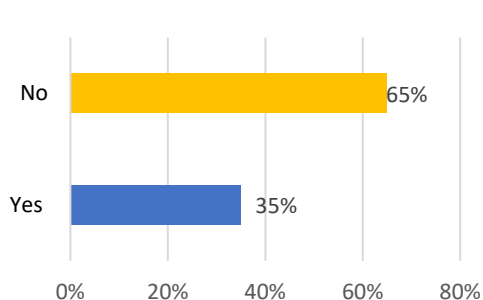


Fig. 9 Training on the use of technology

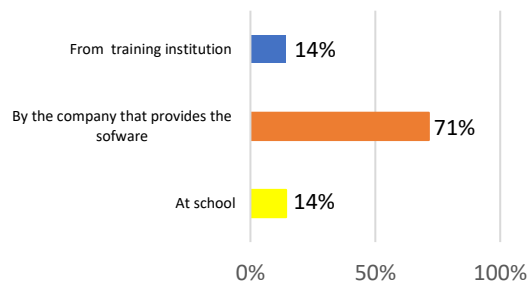


Fig. 10 Institution that provided or organized the training

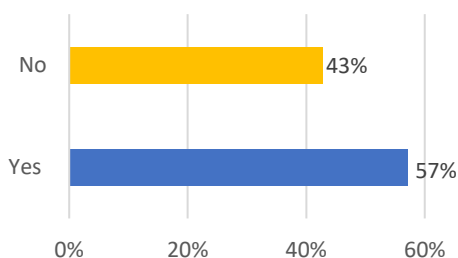


Fig. 11 Usefulness of training received.

3.2.4 The skills required for PA

Farmers believe that the necessary skills for the use of PA machine are at first the information technology, second the economic and business followed by the mechanics and engineering (Figure 12). The Dealers and Manufacturers gave the same importance to the I.T. competences followed by Agronomic 23%. Data Providers and Technology Developers gave instead more importance to the Agronomic competence 29%. About IT competences the most needed are data visualization and data processing, and between Agronomic competences, Recommendation is the most important.

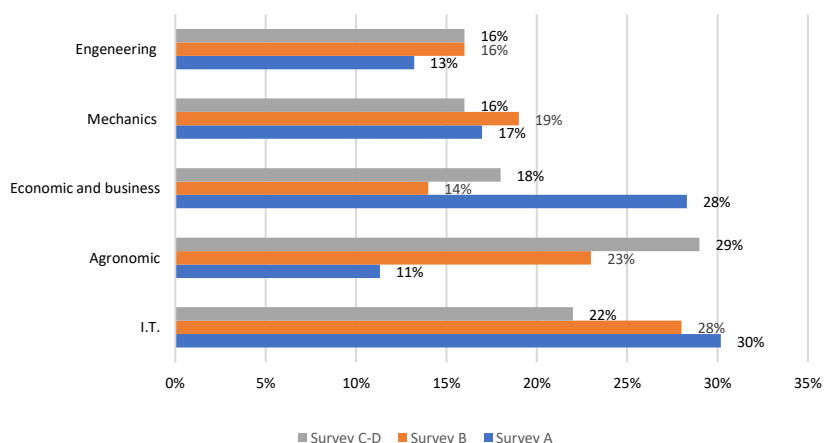


Fig. 12 Necessary skills for the use of PA machinery

The skills lacking in the job market of PA are - as in Figure 13- the IT and agronomy, especially data visualization and recommendation on crop and soil management.

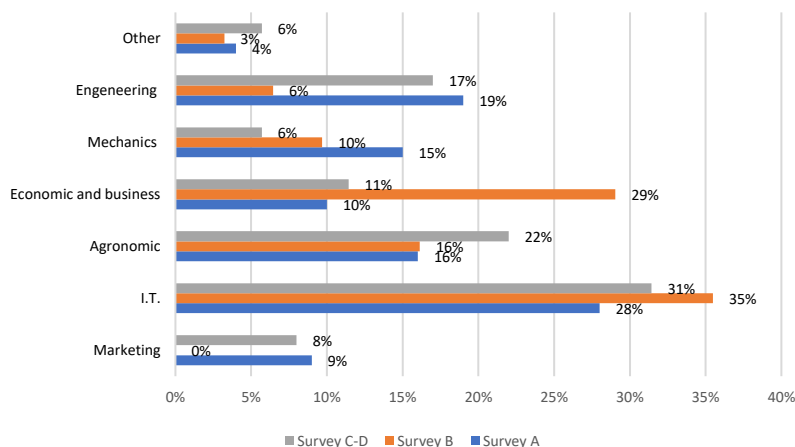


Fig. 13 Skills missing in the job market for all stakeholders.

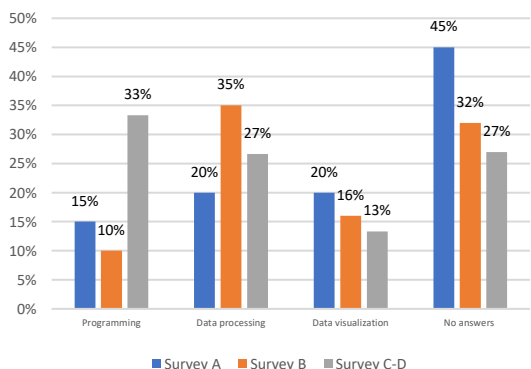


Fig. 14 IT competences lacking in the job market for all stakeholders.

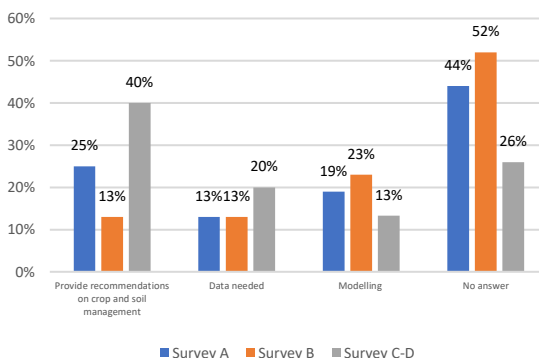


Fig. 15 Agronomic competences lacking in the job market for all stakeholders.

When deepening the skills needed for different job types, we found significant differences among the answers in Group B and Group C (Annex 2).

All the stakeholders agree that using technology for precision agriculture is not easy. On a scale from 1 (extremely complex) to 10 (extremely simple) the average is between 5.6 for Group A and 3.9 for Group C with a standard deviation of 2.1 (Figure 16).

Table 5. Reasons limiting the rapid spread of PA, a summary of the point of view of all stakeholders.

ALL STAKEHOLDERS		
Words from the word cloud	Reasons	Explanation
Technology, data and lack	Lack of Knowledge and Technical Skills	Farmers often lack the necessary knowledge and technical skills to effectively implement and utilize precision agriculture technologies. This includes both understanding the technology and interpreting the data it produces.
	Poor Information Technology Skills	Lack of information technology skills among farmers and a shortage of technical expertise within sales and dealer networks can impede the effective deployment and use of precision agriculture systems.
	Compatibility Issues	Lack of standardization and compatibility between different precision agriculture systems and platforms make it difficult for farmers to integrate various technologies seamlessly.
	Complexity and Lack of Interoperability	The complexity of precision agriculture technologies and the lack of interoperability between different systems and platforms contribute to difficulties in implementation and integration
	Data Privacy Concerns	Concerns about data privacy associated with the collection and analysis of detailed farm data may create hesitancy among farmers to embrace precision agriculture.
Costs and economic	High Initial Costs	The significant upfront investment required for precision agriculture technology, including machinery, training, and infrastructure, poses a barrier, particularly for smaller farms.
	Uncertain Return on Investment	Farmers may be hesitant to adopt precision agriculture due to uncertainty about the actual economic benefits and returns. The potential gains in yield and cost reduction are not always guaranteed.
	Commercial Pressures	Pressure from commercial interests, lack of integration between competing technologies, and uncertainty about long-term agronomic and economic benefits may also be limiting factors.
Knowledge and lack	Lack of Knowledge and Technical Skills:	Farmers often lack the necessary knowledge and technical skills to effectively implement and utilize precision agriculture technologies. This includes both understanding the technology and interpreting the data it produces.
	Poor Information Technology Skills:	Lack of information technology skills among farmers and a shortage of technical expertise within sales and dealer networks can impede the effective deployment and use of precision agriculture systems.
	Insufficient Training	Limited training opportunities for farmers, journeymen, and master craftsmen in the digital field can hinder the understanding and adoption of precision agriculture.

Other reasons	Fear of the Unknown	A general fear of the unknown, along with skepticism and lack of trust in new technologies, may hinder the widespread acceptance and adoption of precision agriculture.
	Age of Farmers	The age of farmers is mentioned as a factor, with older farmers being less exposed to and experienced with agricultural technology, potentially leading to resistance and a lack of willingness to adopt new practices.
	Resistance to Change:	Farmers may resist adopting new technologies, especially if they are comfortable with traditional methods and have concerns about the complexity and usability of precision agriculture tools.
	Limited Government Subsidies	Insufficient government subsidies for improving agricultural equipment and the complexity of the application process may discourage farmers from seeking financial support for adopting precision agriculture.

A number of differences persist between stakeholders. For instance, respondents to Survey A highlight especially the economic issue and the lack of specific knowledge. On the other hand, respondents to Survey B consider system interoperability and usability as the most important among the considered issues. According to Farmers, data providers and Technology developers consider economic problems as the most important barrier to PA spread. For more information on the barriers identified by each Group, see Annex 3.

3.4 Actions needed to facilitate the spread of precision agriculture.

Regarding possible actions that could help enhancing the acceptance and adoption of PA, all stakeholders underline the importance of training and education to technology (Figure 18 and Table 6) while asking for more economic support needed for the AgTech transition.



Fig. 18 Word cloud on action to be taken to support the spread of PA, all stakeholders.

Table 6: Actions needed to improve the spread of PA. Point of view of all Stakeholders

ALL STAKEHOLDERS		
Words from the word cloud	Actions	Explanations
Technologies	Simplification and Usability	Simplify the usage of technologies. Improve usability, similar to smartphones. Standardize technologies to enhance compatibility and ease of use.
	Data Processing and Integration	Focus on data processing in agronomics. Emphasize holistic approaches in precision agriculture
	Global Standardization	Advocate for more European/global standardization to reduce bureaucracy and enhance interoperability.
	Demonstration of Practical Uses	Demonstrate practical uses of the data captured to showcase real-world benefits Conduct on-field demonstrations to showcase the practical benefits of precision agriculture.
Support Economic Cost	Financial Support:	Subsidize precision agriculture with public funds, highlighting its environmental benefits. Increase state and European subsidies for agricultural equipment improvement with simplified application processes.
	Economic Incentives	Create economic advantages for those adopting precision agriculture. Lower the cost of technology to make it more accessible. Demonstrate how precision agriculture optimizes costs and increases productivity.
	Government Policies	Develop a policy framework to address agricultural cost pressures. Support farmers to continue farming and improve long-term reliability.
	Technical Support and Research	Establish strong technical support systems. Invest in research and development for continuous improvement of precision farming technologies.
	Individualized Approaches	Bring individualized economic calculations to farmers to demonstrate the advantages of precision agriculture for their specific circumstances.
Training education	Training and Education	Organize training courses and update personnel to enhance technical skills. Provide comprehensive and serious training to emphasize the economic advantages. Familiarize the next generation of farmers with technology and demonstrate added value.
	Improvement of Skills	Improve the skill set of support staff through training. Support educational systems with a focus on basic education and interdisciplinary thinking.

Other actions	Promotion of Added Values	Demonstrate practical uses of the data captured to showcase real-world benefits
	Awareness and Promotion	Increase awareness and promote precision agriculture across the industry. Conduct marketing campaigns and government support linked to subsidies.
	Collaboration and Communication	Facilitate collaboration among suppliers. Enhance communication between manufacturers, farmers, and agricultural organizations

Farmers responding to Survey A (Table 19) require more training on the use of technology and on practical aspect of precision agriculture, and economic support, whereas respondents to survey B and C-D agree on the need for an increased technology usability, simplification, and standardization, as well as the related education regarding the different aspects of farming linked to the use of this new technology (Table 20).

4. Conclusion

The Survey campaign highlighted the need of more education and training all the stakeholders involved in PA. The implementation of IT skills, economic and business competences followed by agronomics, and engineering knowledge is necessary to address the challenges of PA. These findings are consistent with the aim of LATEST project. Stakeholders required also support from government, researchers and technicians to overcome the barriers that affect the spread of PA. Rather than specific competences, through the survey implemented in PR4.1 we finally could highlight some areas of knowledge were more competences are requested to deal with AgTech transitions in agriculture. During the focus groups expected in PR4.2 we will deepen these findings in order to define specific competences related to these areas of knowledge.

As a conclusion, our study underline that a comprehensive approach involving education, financial support, technological advancements, and awareness campaigns can contribute to the wider adoption of precision agriculture. Addressing these challenges requires a concerted effort from policymakers, industry, and educational institutions to provide support, education and incentives to adopt and benefit from PA. Addressing these challenges is crucial for the successful spread of PA.

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Annex 1 Example of the survey for Group A

A) LATEST Survey

LATEST Survey PR4 - Farmers, Contractors, Land Owners Introduction

1) Select your age group

Mark only one oval.

- Less than 20
- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- Over 70

2) Select your gender

Mark only one oval.

- Male
- Female
- Other

3) Select your level of education

Mark only one oval.

- Middle school
- Secondary school diploma
- Bachelor Degree
- Master Degree
- PhD Degree

3.1) Other. Please specify

4) Select the type of agriculture company you work in

Mark only one oval.

- Contract service
- Farm
- Producers' association
- Land ownership

4.1) Other. Please specify

5) Select your role within the company

Mark only one oval.

- Farmer
- Employee
- Farm worker
- Temporary worker

5.1) Other. Please specify

6) Select the main activity of your company

Mark only one oval.

- Cereals
- Leguminous plants
- Vegetable (including tubers)
- Tree crops (including fruit trees, olive trees, grapevines)
- Industrial crops (cotton, tobacco, linen, soybeans...)
- Spicy crops (fennel, mustard, Cayenne pepper and Chimayo pepper, lavender...)

6.1) Livestock breeding (specify: bovine, ovine, goat, swine, equine, poultry)

6.2) Other. Please specify

7) Select the extension of the area cultivated by your company in hectares

Mark only one oval.

- Up to 0.99
 From 1 to 4.99
 From 5 to 19.99
 From 20 to 49.99
 From 50 to 99.99
 More than 100
 Other:

7.1) Other. Please specify.

8) Select the average size in hectares of the area cultivated/contracted by your company per year

Mark only one oval.

- Below 50
 Between 50 and 99
 Between 100 and 299
 Between 300 and 499
 Between 500 and 699
 Between 700 and 999
 More than 1000

8.1) Other. Please specify

9) Do you use any software to organize the activity of precision agricultural machinery?

Mark only one oval.

- Yes
 No

10) If so, which one?

Mark only one oval.

- FieldView
 XFARM
 AGRIVI

10.1) Other. Please specify.

11) Which kind of technologies are used in your farm?

Tick all that apply.

- GUIDANCE Technology (auto-steering, lightbars, controlled traffic farming)
 RECORDING Technology (soil mapping, canopy sensing, yield mapping)
 VARIABLE RATE Technology

11.1) Other. Please specify

12) Select the kind of data you use (multiple answers are possible)

Tick all that apply.

- Data provided by agricultural machinery
 Satellite data
 Data provided by drones
 Data provided by field sensors
 None

12.1) A combination of data. Please specify

12.2) Other. Please specify

13) Select which activity you use the abovementioned data (multiple answers are possible)

Tick all that apply.

Sowing

- Harvesting
 Fertilization
 Tillage
 Pesticide applications

- Milking
- Feeding the animals
- Forest management
- Company management
- Work organization

13.1) Other. Please specify.

14) On a scale from 1 (none) to 10 (for all activities in the field) select the amount of technology at your disposal for precision agriculture that you use.

Mark only one oval.

1 2 3 4 5 6 7 8 9 10

Non All

15) Have you received specific training for the use of this technology?

Mark only one oval.

- Yes
- No

16) If yes, specify

Mark only one oval.

- At school
- By the company that provides the software
- From a training institution

16.1) Other. Please specify

17) Was the course useful for the concrete use of technology?

Mark only one oval.

- Yes
- No

18) Why? Please specify

SKILLS

19) Select the skills you think are necessary for the use of precision agriculture machinery (multiple answers are possible)

Tick all that apply.

- Information Technology. Go to question 19.2
- Economics and business
- Agronomics. Go to question 19.3
- Mechanics
- Engineering

19.1) Other. Please specify.

19.2) If Information Technology, please specify

Mark only one oval.

- Programming
- Data processing
- Data visualization
- Other

19.3) If agronomics, please specify

Mark only one oval.

- Provide recommendations on crop and soil management
- Data needed
- Modelling
- Other

20) Select the skills lacking in the job market that according to you prevent a faster spread of precision agriculture (multiple answers are possible)

Tick all that apply.

- Information technology. Go to question 20.2
- Economics and Business
- Agronomics. Go to question 20.3
- Mechanics
- Engineering

20.1) Other. Please specify

20.2) If information technology, please specify

Mark only one oval.

- Programming
- Data processing
- Data visualization
- Other

20.3) If agronomics, please specify

Mark only one oval.

- Provide recommendations on crop and soil management
- Data needed
- Modelling
- Other

21) On a scale from 1 (extremely easy) to 10 (extremely difficult) select how easy is for you the use of technology for precision agriculture

Mark only one oval.

1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22) Based on your experience what is limiting the adoption of precision agriculture?

23) Based on your experience, what do you think should be done to increase the adoption of precision agriculture?

24) Would you be interested into participating in further initiatives of the project?

Mark only one oval.

- Yes
- No

25) Would you be interested in receiving further information on the project results?

Mark only one oval.

- Yes
- No

26) If you answered yes to questions number 22 and/or 23, please write your mail address.

Annex 2 Detail of the Skills required for the recruitment of the new staff in the three groups

As regard the Dealers and Manufacturers the most important skill for the recruitment of salesclerk is related to Economic and business 22.7%,

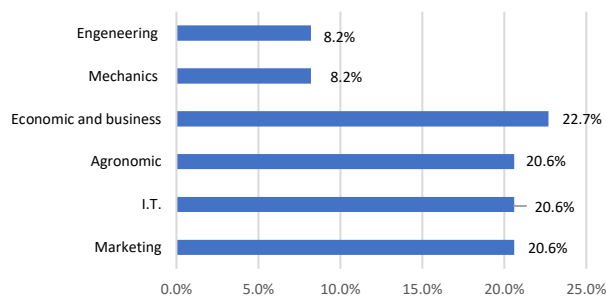


Fig 19 Skills required for the recruitment of salesclerk for PA machinery (Survey B)

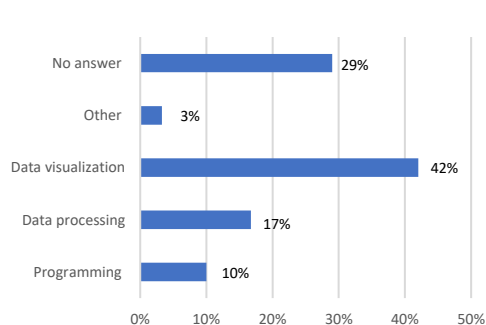


Fig 20 IT competences for required for the recruitment of salesclerk for PA machinery (Survey B)

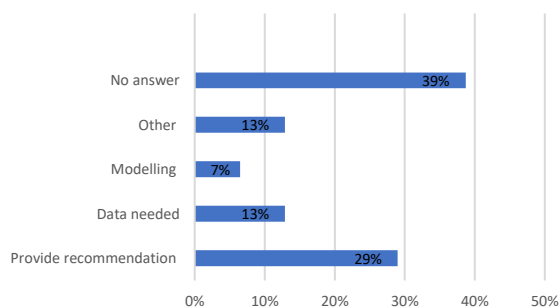


Fig 21 Agronomic competences for required for the recruitment of salesclerk for PA machinery (Survey B)

Skills for the recruitment of new staff assigned to repairing and implementing PA machinery I.T. competences are the most important, followed by Engineering and Mechanics 26%, we can also assume mechatronics skills.

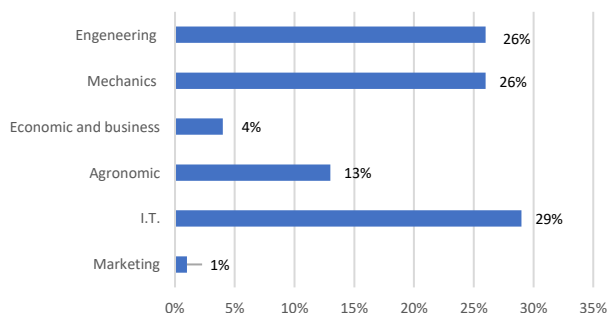


Fig. 22 Skills required for recruitment of new staff assigned to repairing and implementing PA machinery (Survey B)

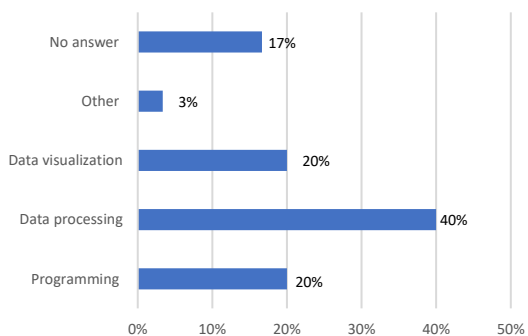


Fig. 23 IT competences for recruitment of new staff assigned to repairing and implementing PA machinery (survey B)

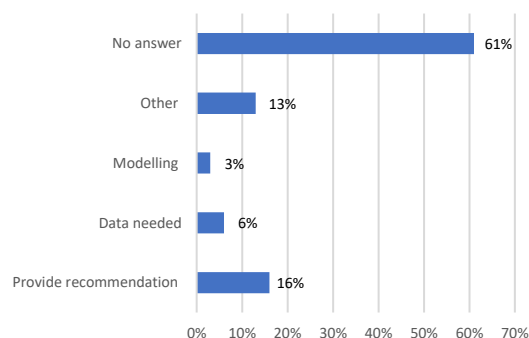


Fig. 24 Agronomic competences for recruitment of new staff assigned to repairing and implementing PA machinery (Survey B)

For the recruitment of new customers’ staff, responders to survey B (Dealers and Manufacturer) indicated the most important IT competencies, followed by engineering 20% and mechanics 18%. Regarding IT competencies the most required are Data processing and Data Visualization.

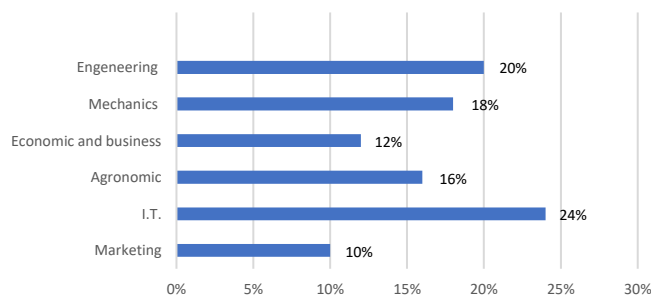


Fig. 25 Skills required for the recruitment of new customers staff (Survey B)

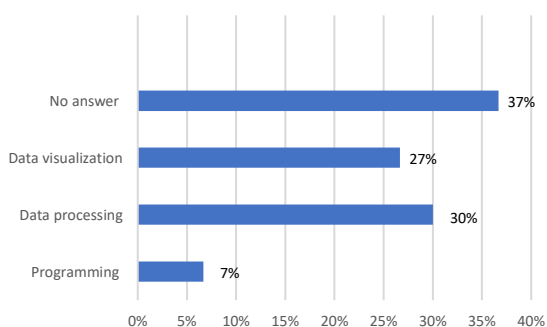


Fig.26 IT competences for recruitment of new customer staff (Survey B)

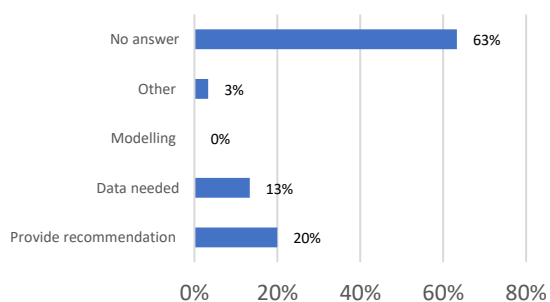


Fig.27 Agronomic competences for recruitment of new customer staff (Survey B)

The Data providers and Technology developers consider the Engineering 23% competences to be fundamental for the recruitment of new staff, followed by IT competences.

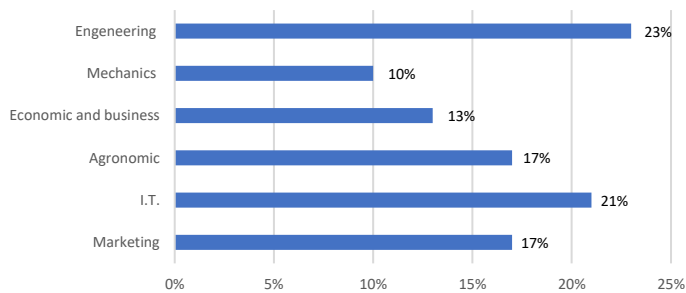


Fig. 28 Skills required for the recruitment of new staff (Survey C-D)

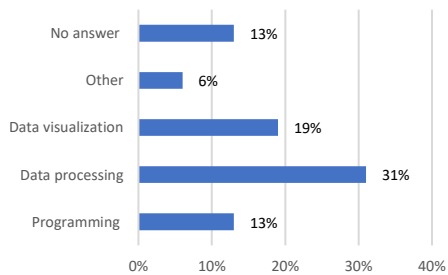


Fig.29 IT competences for recruitment of new staff (Survey C-D)

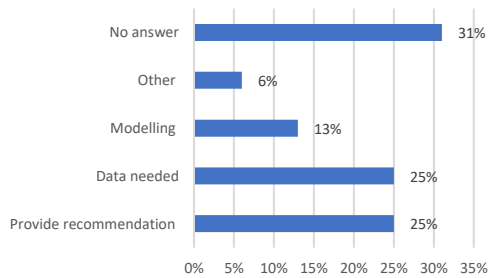


Fig.30 Agronomic competences for recruitment new staff (Survey C-D)

Annex 3 Detail of the reasons limiting the rapid spread of Precision Agriculture in the three groups

Table 7. Reasons limiting the rapid spread of PA. Point of view of Farmers, Contactors and Landowners

SURVEY A – FARMERS, CONTRACTORS, LANDOWNERS		
Words from the word cloud	Reasons	Explanation
Cost (7)	High Initial Costs	Initial investment in precision agriculture technologies is often high. The return on investment is uncertain, making it difficult for farmers to justify the upfront expenses.
	Management Costs and Difficulties	Precision agriculture requires management and technical skills that some farmers may lack. The complexity of managing the technology can be a barrier to adoption.
Economic (3)	Lack of Direct Economic Visibility	The economic benefits of precision agriculture may not be immediately visible to farmers. Uncertainty about the economic returns makes it challenging for farmers to assess the true value of the technology.
	Cultural and Economic Factors	Cultural factors, including a reluctance to leave the comfort zone, may impede adoption. Economic uncertainties and a lack of a clear understanding of the return-on-investment hinder decision-making.
	Cash Flow and Expenses	Managing cash flow and handling ongoing expenses can be a concern for farmers, affecting their ability to invest in precision agriculture.
Knowledge (3)	Limited Knowledge	Lack of knowledge and awareness about precision agriculture technologies among farmers is a significant barrier. Insufficient understanding of the potential benefits and how to integrate the technology into existing farming practices.

Table 8. Reasons limiting the rapid spread of PA, a summary of the point of view of Dealers and Manufacturers

SURVEY B – DEALERS AND MANUFACTURERS		
Word from the word cloud	Reasons	Explanation
Technology (8)	Fear of the Unknown	Farmers may be hesitant to adopt precision agriculture due to fear or skepticism about unfamiliar technologies.
	Rapid Transition from Mechanization to New Technologies	The swift shift from traditional mechanization to advanced technologies poses a challenge for some farmers.
	Accessibility and Affordability	Limited accessibility and affordability of precision agriculture technologies, especially for smaller farmers.

	Interoperability	Interoperability challenges between machines and databases.
Lack (6)	Integration Challenges	Lack of integration between competing and complementary technologies, such as control systems and data handling.
	Lack of Direct Economic Visibility	The economic benefits of precision agriculture may not be immediately visible to farmers. Uncertainty about the economic returns makes it challenging for farmers to assess the true value of the technology.
	Cultural and Economic Factors	Cultural factors, including a reluctance to leave the comfort zone, may impede adoption. Economic uncertainties and a lack of a clear understanding of the return-on-investment hinder decision-making.
	Lack of Competence among Support Staff	Inadequate skills among support staff can hinder effective implementation, exacerbated by the diverse nature of available technologies and interoperability issues.
	Understanding and Training of End Users and Technicians	The need for improved understanding and training of both end users and technicians in the operation and maintenance of precision agriculture technologies
	Qualified Personnel	Lack of qualified personnel who can sell, install, and service precision agriculture products
	Lack of Systems Deployment	Precision farming systems may not be adequately integrated, making it challenging for farmers to extract value from the technology
System (4) Cost (4)	Cash Flow and Expenses	Managing cash flow and handling ongoing expenses can be a concern for farmers, affecting their ability to invest in precision agriculture
	Cost and Multiplicity of Technologies	The overall cost and the variety of available technologies can be overwhelming and limit adoption
	Cost-Effectiveness and Structural Change	Concerns about the cost-effectiveness of precision agriculture technologies and the need for structural changes in farming practices.

Table 9. Reasons limiting the rapid spread of PA, a summary of the point of Data providers and Technology developers.

SURVEY C -D – DATA PROVIDERS AND TECHNOLOGY DEVELOPERS		
Word from the word cloud	Reasons	Explanation
Cost (9)	High Initial Costs and Uncertain ROI	The high initial costs of adopting precision agriculture technology, coupled with uncertainty about the return on investment, can be deterrents for farmers.

	Costs for Farmers	High costs, including software licenses for computers on machines or PCs/mobile devices, can be a significant barrier for farmers, especially if they are not convinced of the economic advantages
	Government Subsidies	Limited government subsidies can act as a barrier to the adoption of precision agriculture, as financial incentives can encourage farmers to invest in new technologies
	Time and Effort for Recommendations:	The time and effort required to derive recommendations from precision agriculture data, along with uncertainty about economic returns, can be limiting factors.
Technology (8) Lack (6)	Complex Technology and Lack of Standardization	Complexity in precision agriculture technology and the lack of standardization can create difficulties in adopting and integrating different technologies
	Lack of Knowledge and Training	Insufficient knowledge and training among farmers, journeymen, and master craftsmen in the digital field can hinder the effective use of precision agriculture tools.
	IT-Skill Disparities	Disparities in IT skills, with farmers often having less expertise, can create difficulties in the adoption of digital technologies in agriculture
	User Acceptance	Farmers' acceptance of new technologies is crucial. Resistance to change and a lack of willingness to engage in smart farming practices can limit adoption.
	Missing Knowledge and Compatibility	Lack of knowledge and compatibility issues among different systems can hinder the seamless integration of precision agriculture technologies.
	Technical Expertise in Sales Networks	The lack of technical expertise within sales and dealer networks can pose challenges in promoting and supporting precision agriculture technologies.
	Lack of Understanding of System Capabilities	Limited understanding of the system and its capabilities can hinder farmers from fully utilizing the potential benefits of precision agriculture.
	Fragmented and Old Data	Unstructured and outdated public data, along with inefficient use of funds and resources in research organizations, can hinder the development of innovative agriculture practices.

Annex 4 Detail of the actions needed to improve the spread of Precision Agriculture from the point of view of the three groups

Tab.10. Action needed to improve the spread of PA. Point of view of Farmers, Contactors and Landowners.

SURVEY A – FARMERS, CONTRACTORS, LANDOWNERS		
Words	Title	Summary
Training (5)	Training and Skill Development	Organize training courses and provide ongoing education to farmers and agricultural personnel. Create comprehensive training programs that emphasize the economic advantages of precision agriculture.
	Increased Training Opportunities	Expand the availability of training courses, including short-term evening courses, to accommodate the schedules of farmers and agricultural committees.
	Practical Focus	Emphasize practical aspects of precision agriculture to make the training more relevant and applicable to real-world farming scenarios.
Economic (2) Cost (2) Support (2)	Financial Support, Economic Incentives	Advocate for public funding and subsidies to support the adoption of precision agriculture, highlighting its environmental benefits.
	Affordability	Work towards reducing the economic barriers by making precision agriculture technologies more affordable for farmers, perhaps through subsidies or incentives.
	Technical Support	Provide robust technical support to farmers, ensuring they have assistance when implementing and troubleshooting precision agriculture technologies

Tab.11 Actions needed to improve the spread of PA. Point of view of Dealers and Manufacturers

SURVEY B – DEALERS AND MANUFACTURERS		
Words from the word cloud	Actions	Explanations
Technology (4)	Ease of Use and Long-Term Reliability	Support farmers in continuing farming by improving the ease of use and ensuring the long-term reliability of precision agriculture technologies.
	Simplification of Usage	Simplify the usage of precision agriculture technologies to make them more user-friendly for a wider range of farmers
Education (4)	Educational and Awareness Campaigns	Conduct campaigns to help farmers understand that precision agriculture optimizes costs and increases labor and crop production.
	Customer Support and Training	Provide more support and training to end-users to enhance their understanding and proficiency in using precision agriculture technologies.
	Promotion and Education	Promote and educate farmers on the benefits and applications of precision agriculture

	IT-Related Agronomic Education	Improve the IT-related aspects of agronomic education to equip farmers with the necessary skills to leverage precision agriculture technologies.
	Flexible Curriculum and Tech Trends	Develop a flexible curriculum that quickly includes new technology trends, such as AI and image processing, into agronomic education
	Improvement of Skills and Systematic Thinking	Systematically improve skills, support educational systems, and foster interdisciplinary thinking to enhance understanding and implementation of precision agriculture
	Capacity Building and Simplification	Focus on capacity building by improving the skills of support staff and simplify the technologies to make them more accessible.
	Early Familiarization and Demonstration	Familiarize the next generation of farmers with precision agriculture technologies from an early stage and demonstrate the added value to encourage adoption.
Support (4)	Government Subsidies and Simplified Processes	Advocate for increased state and European subsidies for agricultural equipment improvements with simplified application processes to reduce bureaucracy.
	Facilitate Joined-Up Development	Facilitate collaboration and joined-up development across sectors, including government, to create a cohesive approach to precision agriculture.
	Policy Framework	Establish a policy framework that addresses agricultural cost pressures and supports farmers in adopting precision agriculture.

Tab.12 Actions needed to improve the spread of PA. Point of view of Data providers and Technology developers.

SURVEY C-D– DATA PROVIDERS AND TECHNOLOGY DEVELOPERS		
Words from the word cloud	Actions	Explanations
Technology (6)	Implementation of Precision Technologies	Implement advanced technologies like machine learning in precision agriculture. Provide more attention and support to farmers in adopting these technologies
	Focus on Data Processing and Holistic Approaches	Increase focus on data processing in agronomics and adopt holistic approaches in implementing precision agriculture technologies.
	Intuitive Software and Economic Modeling	Develop more intuitive software for precision agriculture technologies. Implement economic modeling of outcomes to help farmers understand the financial benefits.
	Usability and Standardization	Make technologies more intuitive and user-friendly, similar to smartphones. Advocate for standardization of file formats and plug/cable connections to ensure interoperability.
Support (6)	Cost Reduction	Address the high upfront costs associated with precision farming by providing subsidies, low-interest loans, or other financial incentives.
	Marketing and Government Support	Conduct marketing efforts to raise awareness about precision agriculture benefits. Provide government support linked to subsidies and organize farmer-led knowledge exchange events.
	Technical Support	Establish a robust technical support system, including hotlines, online resources, and in-person support, to assist farmers in using technologies effectively.
	Research and Development	Invest in continued research and development to create new and improved precision farming technologies
	Global Standardization and Funding	Promote global standardization to streamline processes and reduce barriers. Allocate more funding for startups and reduce bureaucratic hurdles.
Training (4)	Enhanced Training	Increase training opportunities for farmers to improve their skills and make it easier for them to handle precision agriculture technologies.
	Skill Improvement of Support Staff	Enhance the skill set of support staff through training, ensuring they can effectively assist farmers in adopting and using precision agriculture.
	Improvement in Education and Training	Improve education and training programs to enhance the overall understanding and adoption of precision agriculture

Annex 5 Extended abstract accepted for an oral communication at the 15th International Farming Systems (IFSA) Conference

A European perspective on skills needed for digital transitions in agriculture

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Abstract

Several scholars have underlined the role of agricultural digital technologies (AgTech) as one of the main drivers to reach successful agricultural transitions. Indeed, AgTech is expected to contribute to resource savings while increasing on-farm productivity. However, AgTech diffusion in farms is not as fast as expected, moreover the lack of use of new technology represents a new form of digital divide. Our aim is to understand the mismatch between the new skills needed for using digital technologies and the current educational programmes. To better understand perceptions on the skills needed, in this work we present the results of a survey administered with AgTech stakeholders in five European countries. The survey was organized in three parts: respondent sociodemographic, AgTech use and barriers to its diffusion, and perception of the skills required for its use. Findings showed different perceptions among respondents. Nevertheless, all pinpointed similar barriers to the spread of digital technology, confirming a general need for renewed educational and training programmes for better understanding and mastering digital technologies.

1. Purpose

In the last decades, there has been a fast development of digital agricultural technologies (Agtech), expected to contribute to save resources and increase on-farm productivity. Many researchers have analysed the adoption and the different barriers that prevent the spread of precision agriculture (Pathak et al., 2019; Novak, 2021). Several of them have focused their attention on the skills needed to manage the agricultural technologies (Kitchen et al., 2002; Michailidis et al., 2019; Bournaris et al., 2022). The future agricultural workforce will be influenced by technologies and digital solutions that will likely change the way people work (Ayerdi Gotor et al., 2020). However, an accelerating lack of proficiency in operating these digital technologies and devices can be observed. One aspect of this issue may be the mismatch between farmers and training providers due to a lack of communication and

mutual understanding of requirements, opportunities and challenges (Lang & Bleasing, 2022). This research was carried out within the context of the Erasmus+ LATEST project, aimed to understand the mismatch between the digital skills needed and the current educational university programmes. In this framework, we present here the results of a survey made among different stakeholders of the AgTech in five European countries to understand perceptions and barriers on the skills needed for the spreading of AgTech.

2. Design/Methodology/Approach

Table 1 shows data from an online survey targeting 68 actors of precision agricultural technology supply chain, namely farmers and contractors (Group A), dealers and manufacturers (Group B), technology and data providers (Group C) according to the precision agriculture technology supply chain provided by Rizzo et al. (2021).

Table 5 : Survey distribution per stakeholder and country

	France	United Kingdom	Austria & Germany	Italy	Total
Farmers and contractors	2	9	3	8	22
Dealers and manufacturers	6	6	15	2	29
Technology and data providers	1	6	7	3	17
Total per country	9	22	25	13	68

The survey was administered between May 2023 and September 2023 in Italy, France, UK, Austria, and Germany. Stakeholders were selected according to partners' contacts in each country and enlarged until reaching a satisfying numerosity through a snowball approach. The survey included three sections: a sociodemographic part (age, gender, level of education...), a section concerning professional practices, and a third section accounting correspondent experience in precision agriculture with details about the required skills. The definition of the different skills required was implemented through a literature search on the articles and reviews dealing with educational needs for AgTech, having a focus on agronomic and data analysis skills and other skills. This review allowed us to identify six papers indicating several types of skills and knowledge areas (Table 2).

Table 6: Skills needed for AgTech in a literature survey.

Autors	Agronomical skills	Data Analysis skills	Other skills
Kitchen et al., (2002)	Agronomical	Data analysis, GIS, Spatial data analysis	
Bullok et al. (2007)	Agronomical	Data Interpretation	Engineering, Economics
Michailidis et al., (2019)	Agronomical		Environmental, Technical, Management

Baptita, et al., 2021	Agronomical	ICT	Environmental, Management
Bournaris T., et al., 2022			Technological, Legislation, Local community leadership, Business & management, Marketing, Sustainability
Puntel L.A., et all, 2023	Agronomical	Data processing & analysis & interpretation	

For the data analysis of the survey, we performed both a quantitative analysis (descriptive statistics and differences among groups) using the Real Statistics Using Excel software and qualitative analysis on textual responses using TagCrowd to identify the most important items. Last, ChatGPT was used to find the most common discourses per each question of the survey.

3. Findings

As expected, the sample showed a heterogeneous age distribution, with female representation low but homogeneous (10-20%). In the group A, 50% of the activity was in the cereal sector and livestock breeding was less represented. Most of the farms were larger than 100 ha. In the group B, most of the surveyed people are the managers and their clients are mainly farmers or contractors. In the group C, most of the surveyed people were the managers and the 60% were in the precision agriculture sector since less than 10 years; 86% of them provide agronomic recommendations to their clients, which are for a half farmers or manufacturers. Regarding the use of technology in farming, the 60% of respondents declared to use a digital tool for their job. The most commonly used software were Field View and My John Deere. Concerning machine equipment, guidance was the most common (46%) as also underlined by Ayerdi Gotor et al. (2020). Data used by farmers were provided by agricultural machinery 39% and satellite data 30%, and are used especially for sowing, fertilization, and harvest. Only the 35% of sampled farmers had received a specific technological training, in most cases (71%) directly from the technology provider. However, the 43% of them declared that the training was not helpful.

About the skills needed in precision agriculture, there is an agreement among the three groups on the mechanics and the engineering skills, whereas a different importance devoted to economics/business or agronomics according to the group was found. Particularly, for Group A, agronomy & ITC emerge as the most important skills, whereas for Group B and C they are IT and economy/business. Surprisingly, there is no distinction between groups in the ease of use of technology. The skills lacking in the job market of precision agriculture concern mostly ICT, followed by business and economics for the group B, agronomic for groups C-D and engineering for group A. Table 3 summarizes the stakeholders' point of view about the barriers limiting the AgTech spread using the most frequent words appeared in the surveys. There are some differences between the stakeholders, the survey A respondents highlighted the cost as the main barrier, followed by the economic uncertainty about the returns and the lack of knowledge. The focus points of the respondents to the group B are the problems about the use of new technologies: fear of the unknown, limited accessibility and affordability of technologies, interoperability challenges between machines and databases, followed by lack of knowledge, lack of direct economic visibility, lack of competence among support staff. For the respondents from the group C the main barriers are the costs for farmers and lack of competences.

Table 3: barriers limiting the spread of AgTech according to the surveyed sample.

Category	Type of barrier
Technology and data	Lack of Knowledge and Technical Skills
	Poor Information Technology Skills
	Compatibility Issues
	Complexity and Lack of Interoperability
	Data Privacy Concerns
Affordability	High Initial Costs
	Uncertain Return on Investment
	Commercial Pressures
Knowledge	Lack of Knowledge and Technical Skills
	Poor Information -Technology Skills
	Insufficient Training
Other	Fear of the Unknown
	Advanced age of Farmers
	Resistance to Change
	Limited Government Subsidies

Table 4 summarises the answers to the question about what should be done to foster the adoption of AgTech. Even in this case there are some differences between stakeholders. Concerning group A, key actions identified include prioritizing training and skills development, expanding training opportunities, and emphasizing practical applications of AgTech. These measures aim to ensure training relevance and applicability to real-world farming contexts, thereby fostering effective AgTech utilization. Similarly, technology simplification and IT training were found to be relevant also for group B. Stakeholders in the group C highlighted the importance of ease of the technology use and its standardization followed by economical and technical support to farmers and the training for all categories.

In summary, of the action that could be contribute to the wider adoption of Agtech, according to the respondents, are comprehensive approach involving education, financial support, technological advancements and awareness campaigns. Factors such as high initial costs, knowledge gaps, and interoperability issues are identified as key barriers. Overcoming these obstacles is imperative for the successful dissemination of AgTech solutions and their effective integration into agricultural practices.

4. Implications

The goal of this research was to identify the main skills needed for the implementation of AgTech by several stakeholders' groups relevant for its use (farmers, contractors, dealers and manufacturers, technology and data providers). In fact, several authors underline the lack of updating of university curricula on specific skills and competences related to technology and technology use (Charatsari et al., 2023). These university curricula can also be open to professionals through the implementation of micro-credentials (Council of the European Union, 2022) but there are still some institutional

constraints for their development. After a first literature search, we were able to identify relevant domains related to skills rather than specific skills. These domains were used within the survey to identify the main skills needed in the implementation of AgTech. We believe that more qualitative research will support a clearer identification and characterisation of specific skills, starting from group discussion. Some interesting insights from the respondents on the main actions to be implemented to increase the adoption of Agtech were identified, such as “field demo” or “demo on the practical use of data captured” identified mainly by practitioners (farmers, contractors and dealers), or «improve the IT part of agronomic education», «train the farmers» or «more on farm training for staff» underlined that still education and training on AgTech are quite sectoral and lack of interdisciplinarity. This research involved mainly actors close to AgTech, either because they have adopted them in their farm or because they are working in the AgTech field. However, we have to consider that there are still some issues about adaptation of digital innovations to users, privacy and data ownership that should be considered in future trainings and academic programmes. In particular, a transdisciplinary approach linking the different players can support integrative solutions that look at a combination of technological, ethical, social, economic and business challenges (Klerkx et al., 2019).

Table 4: actions to be done to increase the use of AgTech according to the surveyed sample.

Category	Type of action
Technologies	Simplification and Usability
	Data Processing and Integration
	Global Standardization
	Demonstration of Practical Uses
Support Economy / Costs	Financial Support
	Economic Incentives
	Government Policies
	Technical Support and Research
	Individualized Approaches
Training education	Improvement of Skills
	Promotion of added Values
Other actions	Awareness and Promotion
	Collaboration and Communication

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Task 4.2 Focus Groups and Working Sessions

UniLaSalle Focus Group Report

Organization name:	UniLaSalle
Time and date: (from ... to..)	30/05/2024
Where was the focus group organized: (Location name or online)	Campus UniLaSalle, Beauvais
Total number of participants:	4
Number of participants group A: (farmers, contractors, association..)	1
Number of participants group B: (Farm Machinery Dealers -Farm Machinery Producers)	2
Number of participants group C: (Technology developers and data providers)	1
Other participants: (Uni. Professors, Phd,)	2 professors + 1 PhD student

1. Welcome, presentation and warming-up

The moderator and the assistants welcomed all participants at a welcome buffet and thanked them for joining the focus group session. The facilitator appreciated the participants for taking the time to participate, thus explained the purpose of the focus group.

The session began with a quick round of introductions and a warm-up activity to help everyone feel comfortable. The moderator invited participants to introduce themselves. Each participant was asked to share their name and a little about their background. Participants were four:

- 1 farmer (breeder) responsible of the local university farm
- 1 responsible business and marketing at an agricultural equipment manufacturer (KHUN)
- 1 vehicle architecture engineer at an agricultural machine producer (MASSEY FERGUSON)
- 1 product manager at a global corporation in the agricultural technologies (AGCO)

The main part of the session was dedicated to the presentation of research results deriving from project task 4.1. Participants followed the presentation very interested, asking questions around the research approach and commenting the results, which were found in accordance with their perspectives.

Then, the moderator outlined the following guidelines to ensure a productive discussion:

- Confidentiality: participants were assured that everything discussed in the session would remain confidential and they were encouraged to share their honest opinions.
- Participation: everyone was encouraged to participate and share their thoughts, as there were no right or wrong answers.
- Timing: Participants were informed that the session was planned to last 3 hours, with a short break in the middle and a group lunch at the end.

2.The current state of precision agriculture

Concerning the first scenario analysed (Fig.1), the group discussion highlighted the competencies needed for the various profiles. The discussion was centred on three dimensions of competencies (knowledge, skills, responsibility) and four key areas (agronomy, IT, mechanics and engineering, economics and business). A summary for each profile investigated is following detailed:

About **Farmers**, it was stressed the fact that they need to possess a good knowledge of machinery and agronomy. At the same time, they should possess skills in business management and sales to keep/maintain their activity profitable. Participants agreed on the fact that farmers are increasingly reliant on data and technology due to advancements in agricultural machinery, reducing their need for mechanical skills.

Farmer Associations were recognised to play a critical role in providing support and shared resources, also facilitating technology adoption among members. Economic and business management skills had been clearly emphasized to ensure socioeconomic sustainability.

Contractors, seen as larger entities with several employees, they were judged as the most able actors to fill gaps in farm labour and expertise. Participants agreed that they need to be primarily skilled in logistics rather than focusing on deepening agronomic knowledge, considered not very much relevant. Participants highlighted that their main need was to adapt to advanced technology in order to offer specialized services to farmers.

Participants recognized **Machinery Dealers** as the actors mostly needing in-depth knowledge of mechanics and engineering, like machinery producers, and IT to integrate and support advanced machinery. Skills in sales and business management are crucial for successful operations.

Machinery Producers need today to focus on mechanics and engineering, particularly in designing and manufacturing. Moreover, IT competences are essential for integrating advanced

technologies in machinery, while economic and business acumen is necessary for market positioning and competitiveness.

The core competences of **Technology and Data Providers** were clearly IT and data management within agriculture. Participants highlighted the fact that they need to possess knowledge and skills in agronomy to tailor solutions more effectively. Responsibility competencies lie in ensuring the interoperability and applicability of their technologies in diverse farming contexts.

It was noticed that **Consultants** need primarily to hold deep agronomic knowledge. Participants also acknowledged an increasing need for IT skills to leverage data for better crop management and advisory services. Last, economic insight is vital for advising farmers on market trends and financial planning.



Figure 1 - The first session of the FG.

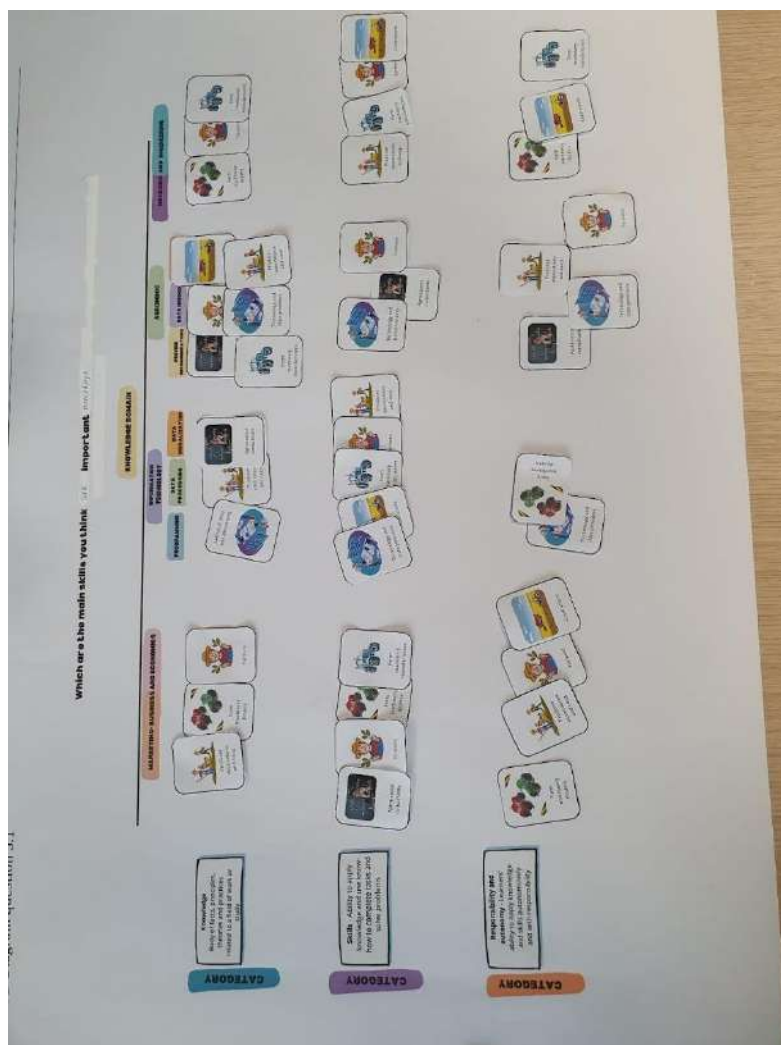


Figure 2 - The matrix concerning the baseline scenario.

3. Future scenarios.

After introducing the future disruptive scenario “Autonomous technology” by the assistant (Fig.3), participants produced the matrix shown in Fig.4.

In such a scenario, participants agreed on the fact that **Farmers** need to develop an understanding of agronomy, including crop management and environmental impacts. They also need basic knowledge of IT to utilize agricultural technology effectively. Practical skills in operating machinery and implementing new technologies were judged as are crucial. Also, in the discussion emerged how farmers should be able to make informed decisions based on technological inputs. About responsibility, farmers were asked to increase their control over farm operations, ensuring sustainable and efficient production practices.

In addition to comprehensive knowledge in economics and business to support member farmers effectively, **Farmer Associations** can enlarge their skills in the areas of management, negotiation, and collective bargaining. They also need to understand agronomy and market dynamics.

In this scenario, participants suggest that **Contractors** should possess in-depth mechanical and engineering knowledge to maintain and operate complex machinery. For that, they require strong technical skills to handle machinery efficiently and a good understanding of agronomy to provide relevant services. Furthermore, they need to ensure they deliver high-quality services to farmers, balancing their operational responsibilities with the need for continuous learning and adaptation. Participants agreed that the role of contractors would be very complex.

Other than extensive knowledge in mechanics and engineering to provide appropriate machinery and support, diagnostics, maintenance, and software updates were seen as critical for **Machinery Dealers**, as they are in charge of ensuring farmers receive reliable machinery and support, facilitating training and troubleshooting.

Machinery Producers must stay at the forefront of technological advancements, with strong backgrounds in engineering and IT. Discussions were centred also on the ability to innovate and adapt products to new market needs. Moreover, they were considered responsible for delivering high-quality, machinery able to meet the needs of modern agriculture.

Other than characteristic knowledge and skills highlighted in the previous scenario, participants agreed that **Technology and Data Providers** should have deep their expertise in data management for cybersecurity issues, also being able to communicate technical concepts to non-experts. In facts, they should provide accurate date and reliable and user-friendly technology solutions to farmers and contractors.

Predominant point of views on **Consultants** were that they should develop analytical and problem-solving skills, along with the ability to interpret data and provide actionable recommendations. They were considered responsible for offering evidence-based advice, helping farmers improve yields, sustainability, and profitability.



Figure 3 - Presentation about future scenario for the AgTech.

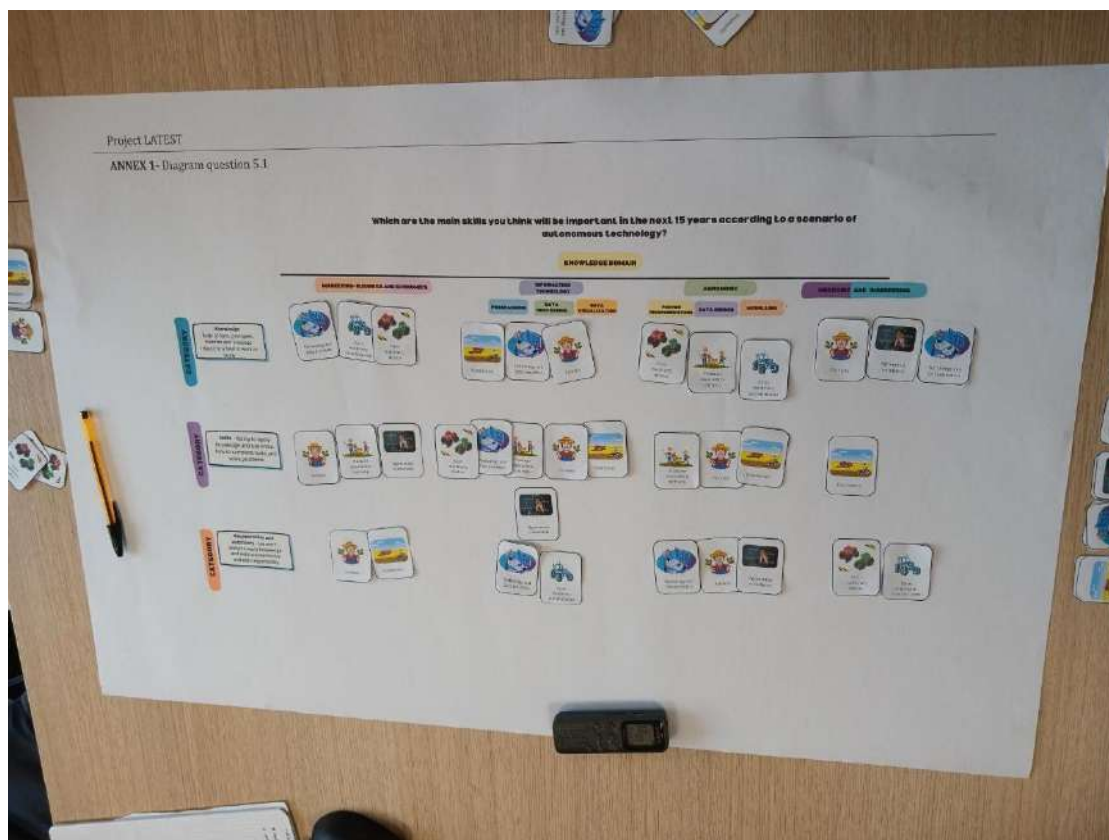


Figure 4 - The matrix concerning the future scenario.

4. Conclusion – final discussion

Notwithstanding the type of scenario analysed, the evolving role of technology in agriculture was a recurrent theme, highlighting the shift from traditional mechanical skills to IT and data management. For the baseline scenario, farmers were seen as needing to be more versatile, with a blend of knowledge and skills across agronomy, IT, and business, while consultants were seen as the actors in the most difficult position as they are facing the challenge of integrating data-driven insights into their traditional agronomic advice. A notable emphasis on the importance of economic and business knowledge across profiles to ensure sustainability and competitiveness in the agricultural sector was noticed.

Future scenario was seen as capable of transforming the agricultural landscape, requiring new competencies in IT and mechanics while integrating advanced technology, such as robotics. According to participants, economic pressures will lead to more capital-intensive agricultural models, necessitating robust economic and business knowledge. At the same time, a need for continuous learning and adaptation across all profiles to keep up with technological advancements and changing market conditions was remarked. The roles and responsibilities of each profile are becoming more specialized, with a clear distinction between those who develop technology and those who apply it.

5. Summary of the Focus Group

Overall impression about the focus group discussion
Satisfactory, very good conversations.

Overall impression about participants
Motivated to the subject and the research activity.

How were the participants to the focus group: interested and reactive, collaborative, silent, passive, inactive, etc.?

All participants were very active. Only one participant showed the attitude to not fully follow supporting questions from moderator and the assistants, appearing focused in discerning his thoughts.

How did you feel as interviewer/moderator/assistant (concentration, external influences, ability to make participants join the discussion, etc.)?

We felt comfortable and motivated in pursuing our tasks. It was also the opportunity for a PhD student to better understand FG operations.

Have you had any problem? (appointment cancelled, missing participants, interviewees/participants' reliability, technical problems, etc.)

A little delay in starting the sessions.

UHOH Focus Group Report

Organization name:	University of Hohenheim (UHOH)
Time and date: (from ... to..)	15.05.2024
Where was the focus group organized: (Location name or online)	online
Total number of participants:	9
Number of participants group A: (farmers, contractors, association..)	1 (Dual function: Farmer and Technology developer)
Number of participants group B: (Farm Machinery Dealers -Farm Machinery Producers)	3
Number of participants group C: (Technology developers and data providers)	2
Other participants: (Uni. Professors, Phd,)	4

1. Welcome, presentation and warming-up

1.1 Welcome and presentation (all participants)

We started with a round of introductions and the presentation of the LATEST project and selected project results from PR 4. We presented just a selection of the PR4 results (also so as not to pre-empt the discussion too much).

The introduction round in plenary – with all participants and UNHOH-Team Members was helpful to get to know each other and was still manageable in terms of time. We close the welcome-session with the presentation of the methodology and rules of the game and division into groups (see presentation). Due to the number of participants, we divided the participants into two groups (blue and orange) for the upcoming status quo and future scenario sessions.

1.2 Warming-up (Group blue)

This group was moderated by Christa.

One participant expressed his dissatisfaction with the results very clearly. He was partly disappointed by the results as they are not meaningful enough as all "bars" are equally high, partly the results were confirmed by the participants' own experiences. There is a consensus on the assessment of farmers. All participants confirm that farmers still have a lot of ignorance. Many are digitally active with What´s app and Co, but are often afraid of using digital tools for farming.

The many part-time farmers in particular have little to do with digitalization. Also due to a lack of training in digital tools.

Before starting the first gaming round UHOH explained how the game works. The differences between the three categories were not immediately obvious to all participants. Clear definitions would have made the explanations easier.

3. Warming-up (Group orange)

This group was moderated by Eva. The group has no comments or additions on the results of PR 4. The player explanations were understood by everyone.

2.The current state of precision agriculture

1. Group blue

2.1.1 Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

During the game the group had some difficulties adhering to the "game discipline". Discussions were held quickly when a card was placed. This may have meant that not all cards could be placed on the playing field. The moderator tried to steer this, but it was not so easy.

In total there were intensive but respectful discussions, complement each other a lot. This was also due to the very diverse perspectives of the stakeholders (e.g. IT farmers versus farmers without IT knowledge). The participants agreed that the most important part of the game was the discussions about the cards that were played. The current status cannot be clearly presented only with one card. Visualisation via board cannot fully depict the dynamics and complexity, which has triggered discussions. One fundamental question was asked: Does it make sense to focus on stakeholders during the game, or would it not be better to abstract to fields of action?

2.1.2 Core results of the discussion

The group had quite a lot of discussions and concluded, knowing full well that this is a possible scenario and a possible distribution, but that there are also good reasons for it being a little different. One reason was that they have quite heterogeneous players, so not every farmer is the same, some farmers have an affinity for IT, some have an affinity for mechanics, some buy in certain activities, others do it themselves and that leads to completely different results on this board. The other thing is that large companies such as the big machine manufacturers like John Deere are so big that they naturally have employees who now have to cover all knowledge domains (IT, Business management, etc.) Of course, each individual employee only has limited skills, but overall, they would probably cover this field completely. Nonetheless, the concentration is somehow in the middle of the board, i.e. between information technology and this agronomic, where a lot will soon be happening, so the decisive factor will probably be that your company or your own group can somehow position yourself there. The claims haven't really

been staked out yet. It's not yet entirely clear who exactly is the service provider that will ensure that agricultural processes are completely digitally permeated, and that this digital permeation will result in added value. They could be contractors, they could be consultants, they could be traders, but they could also be large farmers, it's not entirely clear. But that is one of the core results. In the pure information technology sector (down in the center), are large technology providers such as Google or Amazon, Microsoft etc. It could be, that the big manufacturers will also play a role in this. They should certainly try to get involved. Whether they will succeed is not entirely clear. It's a bit like in the automotive industry. Is VW still managing to keep its hat on in car manufacturing or are they only producing the bodywork and the engines here and in reality, Google is the chain captain in this area? If they don't manage it, then they'll take on a role on the far right, where they'll effectively just be the mechanics supplier.

2.1.3 Add photo of the completed matrix (matrix with cards placed by the participants)

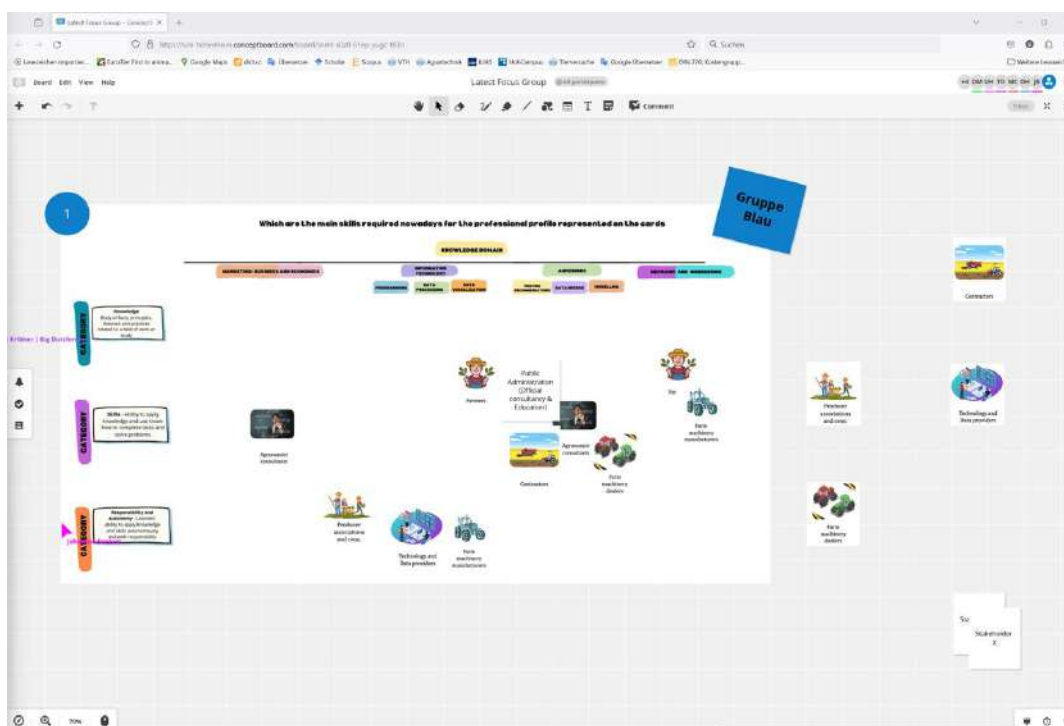


Figure 1: Completed matrix for the status quo (Group blue)

2. Group orange

2.2.1 Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

The group has dealt a little with the wish-reality scheme, in general.

2.2.2 Core results of the discussion

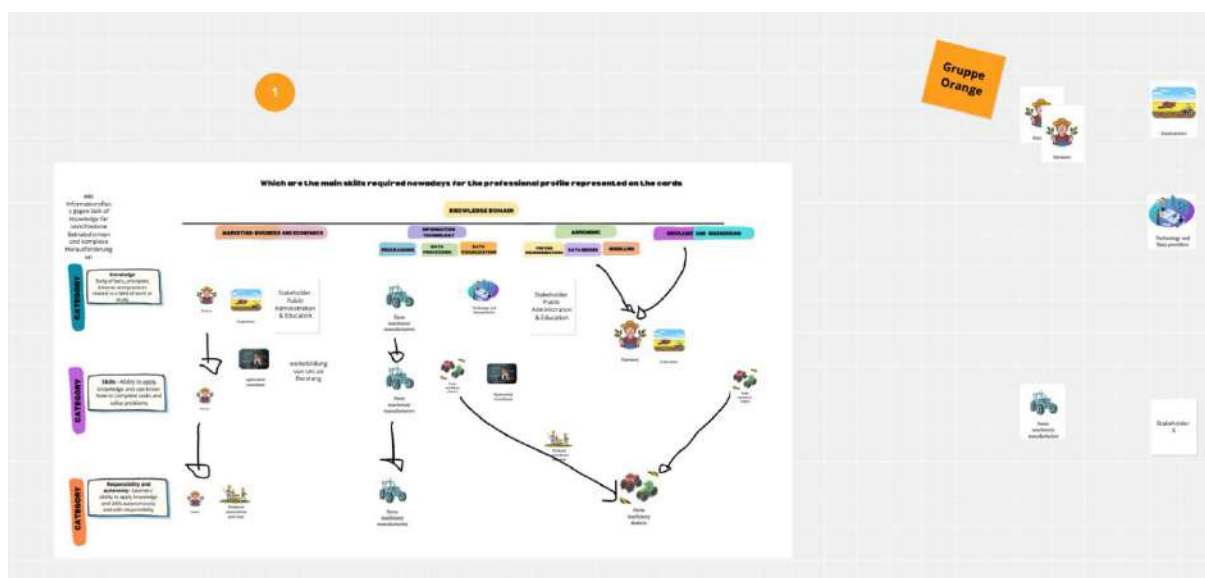
They added public administration and public education as additional stakeholders, albeit assigned differently. The group tried a little bit to grasp the dynamics of this. So there are actually

expectations at different levels of everyone who should be able to do everything. That's why they tried to use the case to illustrate a certain build-up of expertise starting from there. Also interesting is, that this group not differentiate between farmers, contractors or cooperatives, but rather say who is the decision-maker, what is the purpose of their decision and what competences or skills do they need to be able to make a good decision.

The group saw a certain development for all stakeholders, starting with and at all levels, to the effect that they must first understand what they are actually talking about, what they are actually dealing with, what the tools that are now being given to them here are. They also need to understand what they are supposed to be able to do, practise using them and then assess the consequences accordingly, along the lines of "what happens if I use this tool".

In this respect, this group has not defined this board so clearly compared to the future scenario or what we still assume to be the future scenario when we talk about the future.

2.2.3 Add photo of the completed matrix (matrix with cards placed by the participants)



3. Future scenarios

3.1 Group blue

3.1.1 Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

The Group is of the opinion that some players may disappear, or they may be involved in new and more topics. New players may emerge (input companies such as BASF or external remote service centres). Food retailer will be central players for this group in the future. Or they will simply change, adapt, rather new business models for existing players.

The most important stakeholder in the future scenario for this group will be the Technology and data provider. The group expects, that the market will be divided into a few, very large ones. Small stakeholders will disappear.

2. Core results

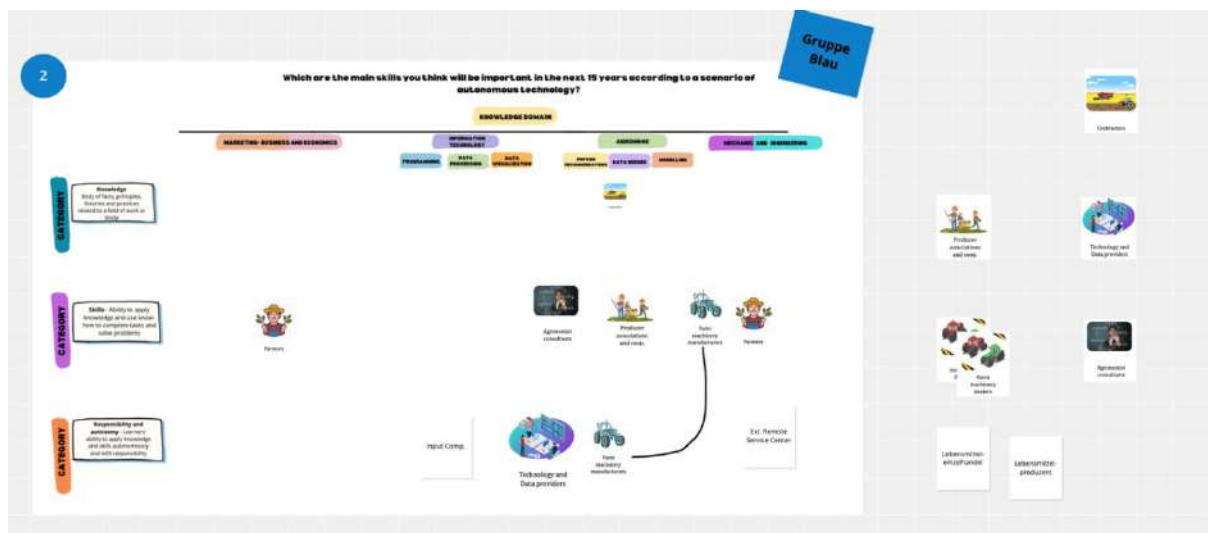
The group participants agree that the necessary skills will still be similar in 15 years' time. The only question is where they will be located and with which stakeholders. For example, the group included the technology provider as a very important partner, perhaps in cooperation with the input companies or in cooperation with the machine manufacturer. Furthermore, the group already has seen that they are joining forces, for example a John Deere with an AWS or a Google, or a BASF, all will play an important role. The farmer as such is basically just the production process, which will probably run completely automatically in the future, optimise itself automatically, make a few inputs in this production process. The group discussed a lot about the fact that the farmer can be creative in the output of this, i.e. the goods that come out of the production process, in sales through marketing measures, through region-specific marketing measures or then sell his goods intelligently through marketing.

The question the group has asked themselves is “who is in charge of these processes”, i.e. who holds the reins in their hands, which today is also one of those black-painting scenarios that are presented to farmers. The scenario that was presented in 15 years' time is, that the farmer is only the owner of the land and only monitors and perhaps adjusts the production process a little due to external requirements, including retail. For the group service centres will play an important role in the future, i.e. machines will be restarted or adjusted or even restarted remotely, similar to the video referee that we already have in football, where someone watches the machines remotely.

The group asked themselves what qualifications are necessary, but they actually came to the conclusion that similar qualifications are necessary, but that they no longer necessarily have to be with the stakeholders where they are today, i.e. that the expertise we teach today will only be used in other stakeholder areas. It was an important realisation, that in the future scenario will also be administrators in the middle of the board or the consultants. And that the consultants will then advise several companies remotely in the future, similar to the service centres, controls.

The group also expects more partnerships (e.g. equipment manufacturers with large tractor manufacturers) in order to be able to place their machines on the market at all, because that's just an attached device and the main player is the tractor manufacturer with its platform in order to be able to survive at all. And the farmer, in the future actually only provides specifications in the production process, in the marketing etc.

3. Add photo of the completed matrix (matrix with cards placed by the participants)



3.2. Group orange

1. Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

For this group the scenario is perceived as rather frightening. Farmers are just "pawns". The group did not want to go along with the entire scenario and work on the board. They decided that there was consensus in favour of the first part of the definition of the future scenario. That's why they then played on the board in this light, but did not finish the game as there was a lot of discussion. E.g. : "You could actually copy the status quo board and emphasise the responsibility level for everyone".

Difficulty for some of the participants to simply get involved in the scenario, some are overly intellectual, reasons why it can't or shouldn't be like this.

3.2.2 Core results

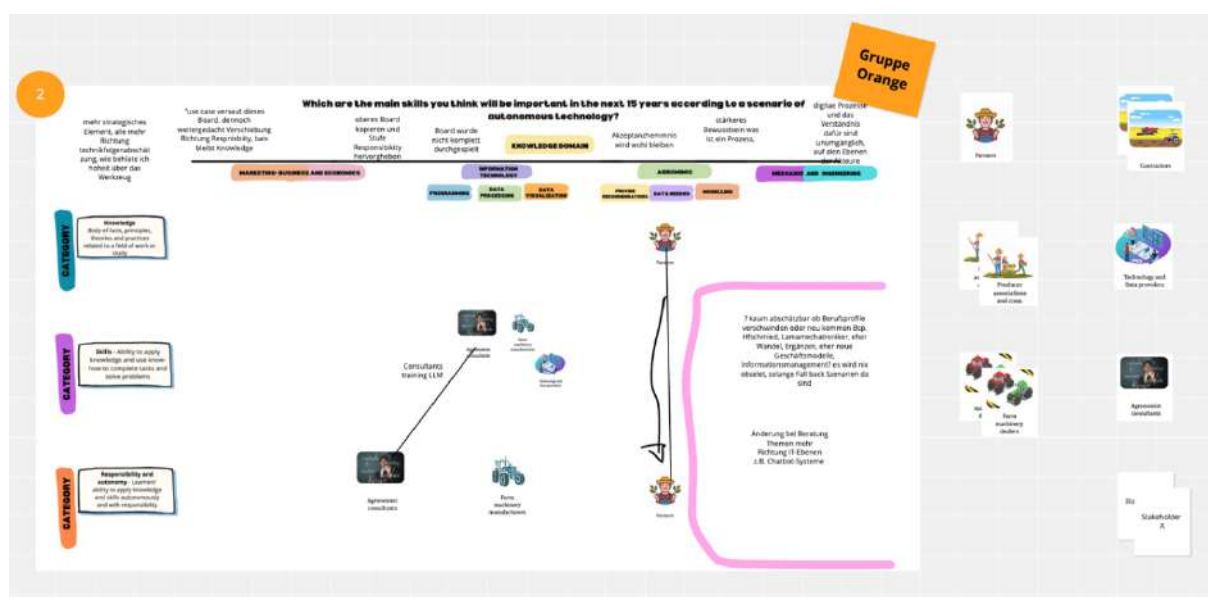
This group struggled with the definition of the future scenario. They started to discuss the future scenario because they had problems with the second paragraph in particular. It more or less questioned their understanding of the mandate that they were supposed to implement. They assume that the stakeholders have economic interests and will defend them, and that will be a key point where digital technologies will or will not meet with acceptance. They criticised that this scenario was formulated along the lines that the farmer or the existing stakeholder will willingly or unwillingly surrender their economic interests to an unknown third party. One person just described it as possible doom and gloom, but whatever kind of painting it is, the picture is there. And the question is, what do we make of it now?

The group tried to focus on what will shift between now and the future. And they are actually of the opinion that it won't be that much. What will happen is that in the future we will need a lot

more advisory expertise, whether it comes from the official, i.e. official advisory side or independently.

Up to now, advice has been very production-related and the group believes that this will shift towards production processes being more or less known, automated and taken over by technologies, so that advice will be shifted more towards how the technology works, i.e. another level of understanding. And the second thing is that many, whether they want to sell something to the farmer or are the farmer themselves or an association of farmers, many have to think much more about what consequences the use of which tool will have strategically for my company. So it's not necessarily the level of automating the process, but also how does it shift my weight in the value chain? Overall, the scenario outlined has narrowed down the task for this group a little at this point.

4. Add photo of the completed matrix (matrix with cards placed by the participants)



Autonomes Technologie-Szenario

Im

Szenario der autonomen Landwirtschaftstechnologie tauschen die landwirtschaftlichen Systeme automatisch Daten aus und kommunizieren digital. Digitale Technologien und Algorithmen, die Probleme in den Bereichen Umwelt, Lebensmittelsicherheit, Tiergesundheit und Tierschutz lösen, treiben den Agrarsektor voran. Dazu gehören Roboter und Algorithmen, die die Arbeit ersetzen und das Wissen für die Entscheidungsfindung in den Betrieben liefern. Da die Daten offen sind, können alle Akteure, einschließlich landwirtschaftlicher Betriebe, Technologie- und Lebensmittelunternehmen, Behörden und Verbraucher, Daten gemeinsam nutzen.

Dennoch werden die Landwirte zu bloßen Ausführenden von kapitalgesteuerten Algorithmen, die Big Data nutzen. Produktionsdaten haben einen Wert und Unternehmen verknüpfen Verbraucherdaten mit landwirtschaftlichen Technologien. Da Daten für einen erfolgreichen Betrieb, z. B. durch Systemoptimierung, entscheidend sind, ist die Bereitschaft aller Akteure, Daten zu teilen und Technologien zu nutzen, die den Datenaustausch erleichtern, hoch. Die Akzeptanz digitaler Technik ist in der Gesellschaft generell hoch, bei den Landwirten jedoch weniger einheitlich. Die Wirtschaft akzeptiert die autonome Agrartechnologie, wenn sich dadurch Geschäftsmöglichkeiten ergeben. Die Regierung zeigt Akzeptanz, wenn sie die Algorithmen und Daten nutzen kann, kämpft aber darum, die Kontrolle über die Technologien zu behalten. Die digitale Kompetenz ist unausgewogen. Die Landwirte sind weniger in der Lage, digitale Technologien zu beeinflussen, als vielmehr die Befehle der Technologien auszuführen. Sie lernen, wie man digitale Befehle ausführt, wenn keine autonomen Geräte sie ersetzen. Die digitale Technologie passt sich schnell an die lokalen Gegebenheiten an und steuert zunehmend die Generierung von Informationen. Offene Daten und transparente Wertschöpfungsketten ebnen die Spielregeln für Unternehmen und erhöhen die Innovationsrate. Unter der Macht der digitalen Technologie werden Landwirte zu bloßen Ausführenden, während der Staat nicht Schritt halten kann. Dennoch wird die autonome Landwirtschaft durch politische Maßnahmen geschützt. Die algorithmusgesteuerte Ausrichtung der Politik bedeutet, dass die Agrarpolitik in die Technologie eingebettet wird. Sie ist in dem Maße proaktiv, in dem die Regierung Zugang zu Daten erhält und Algorithmen durch Vorhersagen, die auf den generierten Daten basieren, politische Probleme identifizieren. Die Agrarpolitik sieht sich dennoch mit Zielkonflikten konfrontiert, einschließlich Konflikten zwischen Landwirten und Algorithmen. Private Unternehmen und die Regierung, die ein großes Interesse an einer erfolgreichen autonomen Landwirtschaft haben, stellen die digitale Infrastruktur bereit.

unzutreffend, wird nicht mitgedacht beim "Spiel"

4. Conclusion – final discussion

In a final session, all participants came together once again to present the core results to each other. One spokesperson from each group presented their boards briefly (2-3 minutes) in plenary. Direct comparison of status quo and then future scenario. Similarities and differences became clear. Overall, it was criticised that there was a lack of reference to agricultural training, or that a combination of vocational training and universities should be considered (Australian model) and more dual training models should be created. Overall, more global thinking was called for. Asia was cited as an example, where more pragmatism and speed prevail in the development and adaptation of technologies.

The participants hope, that the project will lead to more pragmatism in the transfer of knowledge to all players, not just students. Furthermore, they hope that the project will lead to future-orientated structuring of teaching, overview of all areas exciting, not just one's own area, new thinking a exemplary methods from other countries "farmer doesn't care where/from whom info comes from, only the info itself is important".

5. Summary of the Focus Group

Overall impression about the focus group discussion. Overall impression about participants. How were the participants to the focus group: interested and reactive, collaborative, silent, passive, inactive, etc.?

How did you feel as interviewer/moderator/assistant (concentration, external influences, ability to make participants join the discussion, etc.)?

Have you had any problem? (appointment cancelled, missing participants, interviewees/participants' reliability, technical problems, etc.)

UNIHO finalised the Focus Group with a feedback round. Overall the topic of the focus group workshop was an important topic for all participants. The group pointed out, that the cross-domain work was very good, exiting and interesting. Especially the mix of domains (participants) was very good.

The feedback of the group was that the current situation was well presented by both groups. Some of the participants could take away some new impressions. One main critical point was that maybe the focus on stakeholders is not perfect and that it could be difficult to determine the current status for outstanding people, why the discussions around the tables were so important.

Finally, the participants hope, that the results of the project will bring new impulses from other countries into the german education system.

UNIHO was very satisfied with all participants and the work in the two groups. All participants were motivated and interested, complemented each other well and everyone was able to make his point. They were critical and thoughtful, and willing to shape things. Just one participant must leave after the lunch break and missed the second part. Overall, the methodology was very well suited to mapping it digitally with the tools used.

The moderators felt concentrated and focussed. During the day everything worked out very well for the moderators. It was not always easy to find a balance between moderating, steering, letting things run and joining in the discussion.

HAU Focus Group Report

Organization name:	Harper Adams University (HAU)
Time and date: (from ... to..)	19 July 2024 (11.00 – 14.00 including lunch)
Where was the focus group organized: (Location name or online)	In person, in the Agricultural Engineering Innovation Centre at Harper Adams University
Total number of participants:	6
Number of participants group A: (farmers, contractors, association..)	1 (Dual role: Post-grad researcher and farmer)
Number of participants group B: (Farm Machinery Dealers -Farm Machinery Producers)	1 (Dual role: MEng student and farm machinery producer)
Number of participants group C: (Technology developers and data providers)	0
Other participants: (Uni. Professors, Phd,)	3
Moderators:	1

1. Welcome, presentation and warming-up

Dr Paula Misiewicz welcomed the participants, introduced herself and introduced the Erasmus+ LATEST project and presented the results of the PR4 survey. Both during and after the presentation there were many questions, thoughts and ideas related to the survey findings. This developed into a good discussion which covered many ideas, such as the following:

- Show the responses from different countries / job role breakdown
- Variation in the data could be related to variations between countries and individuals (early adopters versus conservative individuals)
- Data integration has been an issue for many farmers, also data processing, for example linking soil mapping with crop yields
- Technology needs to be simpler and more user-friendly (such as smart phones)
- Interesting to see that the representatives of group B and C do not say that agricultural technology is easy to use
- Who is the future MSC aiming for – group A/B/C – needs to have a lot of flexibility and be adaptable
- Training needs to catch up with the current technology – software training, technology training for farmers
- The manufacture representative stated that it is clear that staff working for manufacturers do not get appropriate training and need to learn themselves
- Technology is good but only if the operator is good
- We should be learning from past lessons (eg smart phones, electric cars, autosteer on tractors)

After the discussion, there was a round of participant introductions. As per the table above, unfortunately there were no representatives of group C (Technology developers and data providers) and the majority of participants represented the group called Other. This was not a problem, as most of them had a strong understanding of the agricultural technology state and needs (being lecturers / PhD students in the Engineering Department of Harper Adams University).

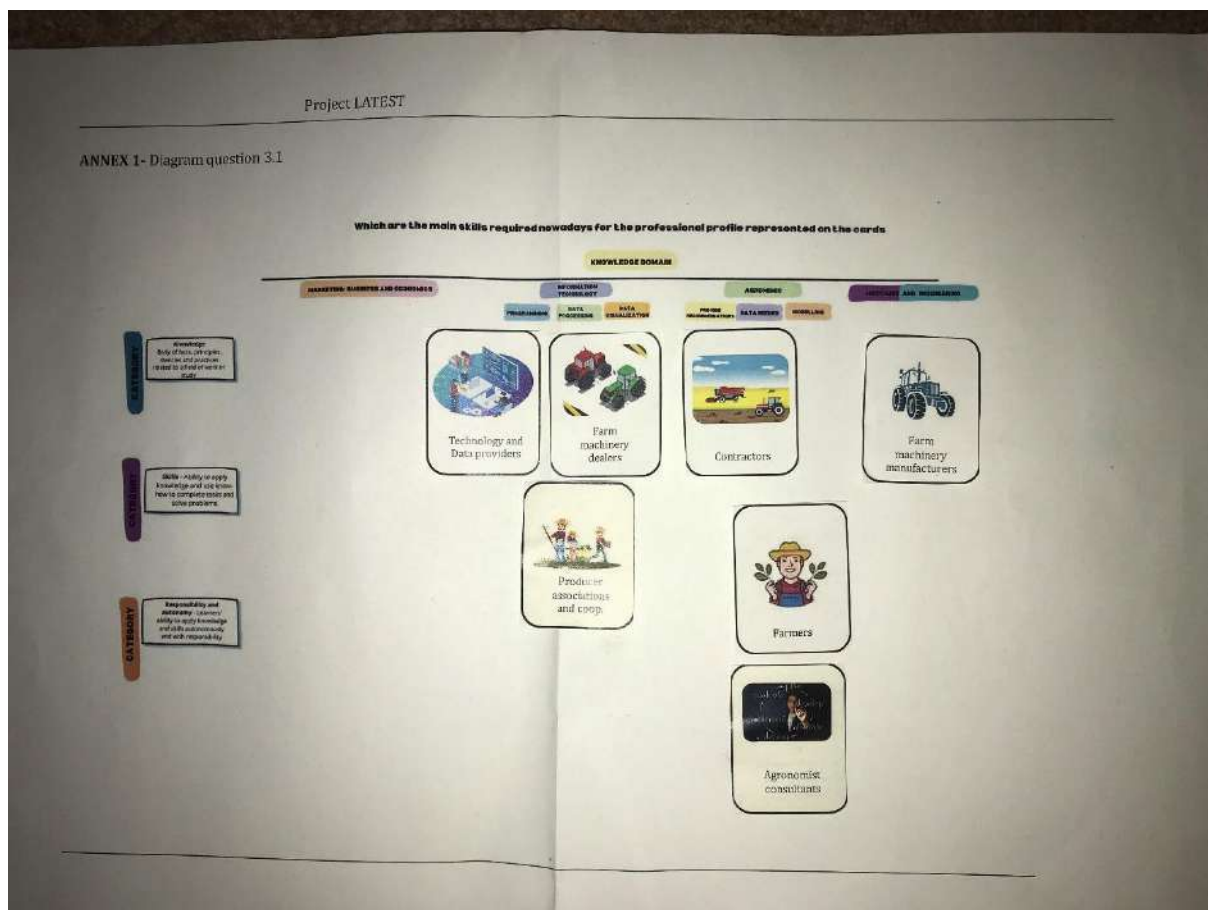
Further Paula introduced the methodology and rules of the game and decided to work as one team (due to the number of participants).

2.The current state of precision agriculture

Overall, the game generated interesting discussions, mostly linking with the points listed above. It was concluded that was difficult to assign the stakeholder locations onto a 2D image, many needed to cross and bridge between knowledge domains and categorise as agricultural sector is very dynamic and complex.

The discussions concluded that farmers do not know what the future is going to bring but a more digital farm office can be beneficial. However, strong and reliable infrastructure and knowledge are needed for that. As contractors provide service, the more technology they use the better the service they will provide. Further we moved onto the government responsibility in understanding the sector, its needs and pressures, which should then translate into appropriate policies.

As per the image below, agronomy was the main knowledge domain recognised for farmers, contractors and agronomists. While IT technology was the main domain for technology and data providers, farm machinery dealers and farming associations. Machinery manufactures were to concentrate on mechanical engineering domain. In terms of the different categories, both 3 were recognised to be crucial.

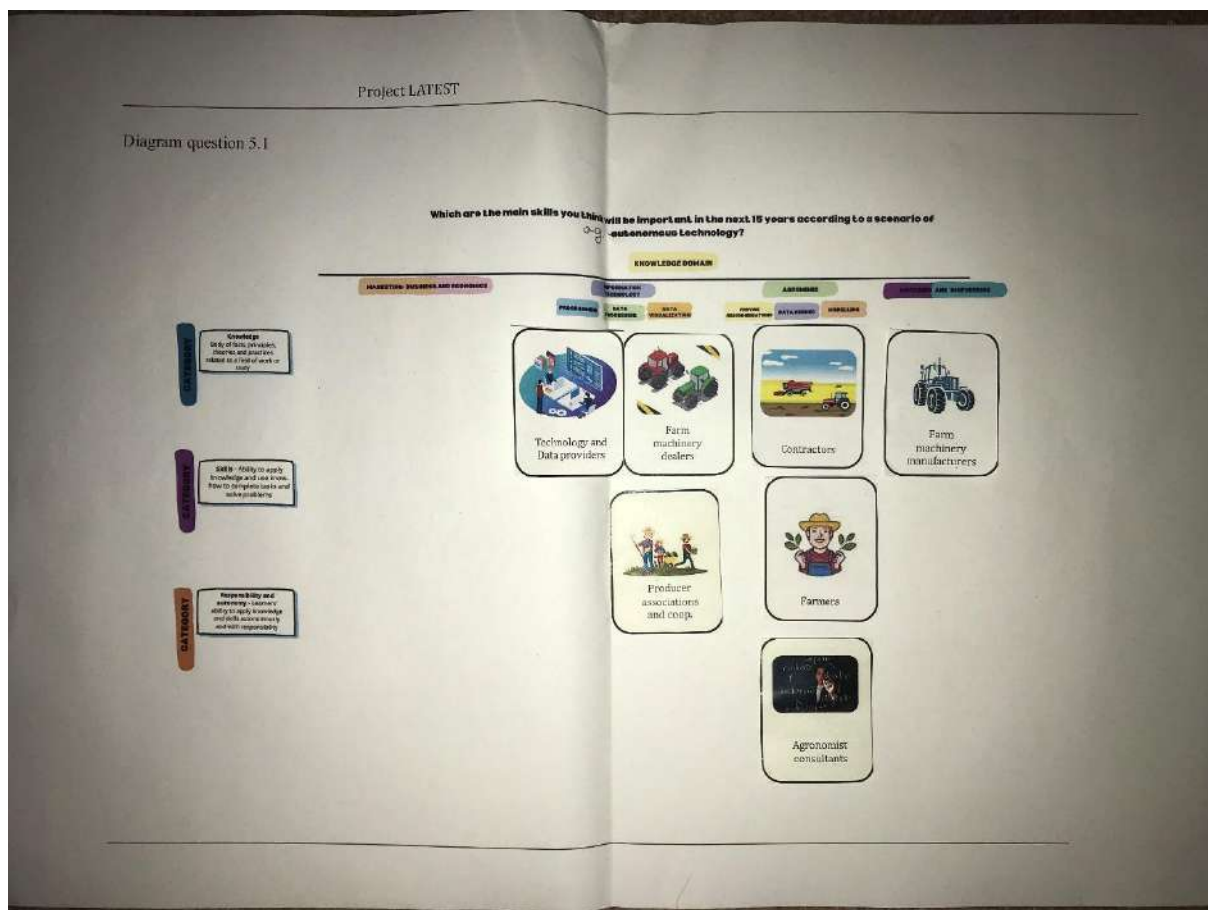


3. Future scenarios.

Interestingly, when considering the next 15 years, it was agreed that the same set up of priorities is required as per the current scenario (image below).

In the conversation, new roles and responsibilities were discussed. Most participants agreed that they would not expect any new roles to evolve or some current roles to disappear, but they would expect all roles and skills to be more diverse and flexible.

Further during our lunchtime discussions, the participants asked if it was possible to create any additional stakeholders, especially government and policy makes, as they would be crucial for future improvements. Additionally, retailers were suggested as very powerful and important stakeholder.



4. Conclusion – final discussion

The participants agreed that the current and future stakeholders' priorities necessary skills will still be similar in 15 years' time. They agreed with the huge importance of the agricultural technology sector in the current and future times to support sustainable agricultural production. Further, they highlighted the importance of education and the other issues as listed in the presentation.

5. Summary of the Focus Group

I felt the focus group went well. The participants really enjoyed the discussions, were very engaged and interested. It would have been better to have a larger group of participants.

One participant recommended looking at the Engineers 2030 - a policy project, led by the Royal Academy of Engineering (on behalf of the National Engineering Policy Centre) to rethink engineering and technology skills for a world in which both people and planet can thrive. The Engineering Department of Harper Adams University is currently in the process of reviewing the progress of this project: <https://nepc.raeng.org.uk/engineers-2030>

UNIUD Focus Group Report

Organization name:	University of Udine (UNIUD)
Time and date: (from ... to..)	23.05.2024 from 14.15 to 18.30
Where was the focus group organized: (Location name or online)	University of Udine – Via delle Scienze 206
Total number of participants:	15
Number of participants group A (farmers, contractors):	3
Number of participants group B (Farm Machinery Dealers -Farm Machinery Producers):	0
Number of participants group C (Technology developers and data providers):	2
Other participants:	4 from Regional Agency for Rural Development (ERSA)
Other participants: (Uni. Professors, Phd,)	2 Uniud
Moderators	5

1. Welcome, presentation and warming-up

The professor Elisa Marraccini introduced the Erasmus+ LATEST project and presented the results of the survey campaign. After the presentation there was a round of introduction of the participants and the speakers. A brief discussion was conducted about the underrepresentation of the group B in Italy. For some of the participants this is due to the lack of competences on AgTech of this sector related to the high age average of Machinery Dealers.

Subsequently the main group was divided into two heterogenous small groups located into different rooms.

Group A was composed of 3 farmers, 1 data provider, 2 from Regional Agency for Rural Development (ERSA FVG), 1 professor of UNIUD expert in viticulture.

Group B was composed of 1 farmer, 1 data provider and technology developer, 2 form Regional Agency for Rural Development (ERSA FVG), 1 professor of UNID expert in agronomy

2. The current state of precision agriculture

The two groups worked differently.

Group A debated more and then the participants positioned cards on the matrix making more selection and changing position more often. Some participants of this group highlighted the necessity of a more involvement of the Farmers and Contractors from machinery producers and technology developers.

The group B worked in a more systematic way, choosing from time to time a professional figure and placing it on the Knowledge Domain on the matrix. This group decided that to discuss about competences in AgTech the Farms must be at least 100 hectares, and the term modelling was intended as forecasting ability to make deductions not as I.T skills.

A contractor affirmed that the professional profile more needed today is the tractor driver with knowledge in mechanic, I.T. , English and agronomy .

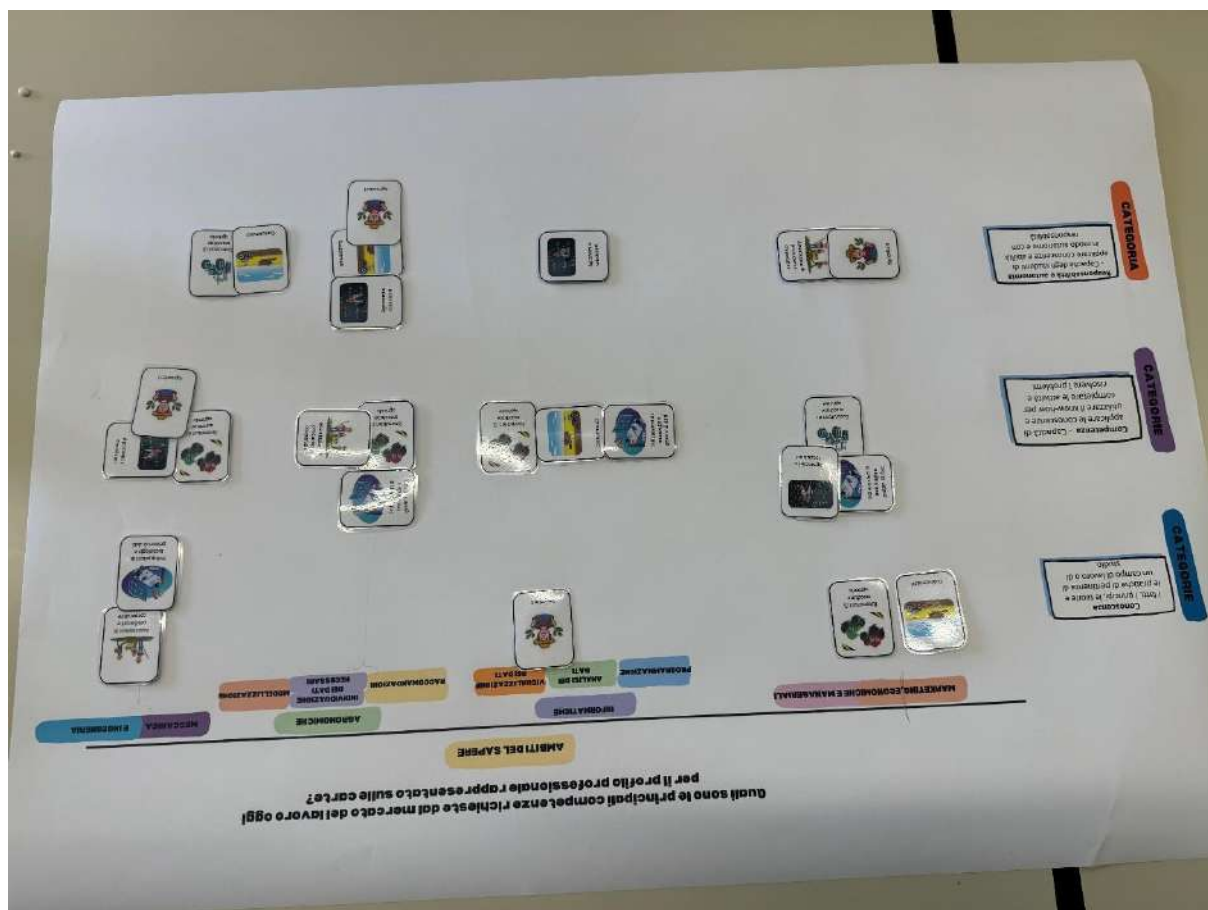
Results of group A:

Actors	Level of knowledge	Knowledge Domain
Farmers	Responsibility and autonomy	Economic, business and marketing
	Responsibility and autonomy	Agronomy
Technology developers and data providers	Responsibility and autonomy	I.T.
	Knowledge	Agronomy
Consultants	Responsibility and autonomy	Agronomy
	Knowledge	I.T: Programming and data analysis
Farm machinery manufacturers	Responsibility and autonomy	Engineering and mechanic
	Skills	Agronomy
	Knowledge	I.T.
Contractors	Skills	Mechanic
Farm machinery dealers	Skills	Engineering
Producers' associations	Skills	Economic, business and marketing



Group B results:

Actors	Level of knowledge	Knowledge Domain
Farmers	Skills	Data analysis and Data visualization
	Responsibility and autonomy	Agronomy
	Knowledge	Mechanic and Engineering
Technology developers and data providers	Skills	I.T.
	Skills	Economic business and marketing
	Skills	Agronomy
	Knowledge	Mechanic and Engineering
Agronomists and Consultants	Skills	Mechanic and Engineering
	Skills	Economic and business
	Responsibility and autonomy	I.T.
	Responsibility and autonomy	Agronomy
Farm machinery manufacturers	Responsibility and autonomy	Mechanic
	Skills	Economic and business
Contractors	Knowledge	Marketing
	Skills	I.T.
	Responsibility and autonomy	Agronomy
	Responsibility and autonomy	Modelling
Farm machinery dealers	Skills	Economic and business
	Knowledge	Recommendations (Agronomy)
	Knowledge	Mechanic
Producers' associations	Skills	Mechanic and Engineering
	Responsibility and autonomy	Economic, business and marketing



3. Future scenarios.

The group A discussed a lot about which professional profile will remain in the future scenario, and which one will change

At the end of the discussion, was decided that:

The producers 'associations won't exist because the aggregation won't be necessary the algorithm will decide everything and also the contractors won't exist because the Farmers could rent machinery and workers (if the robots don't are able to do some kind of works in the field) from the new professional profile the "Service Provider".

The Farm machinery producer will become the "Service Provider"

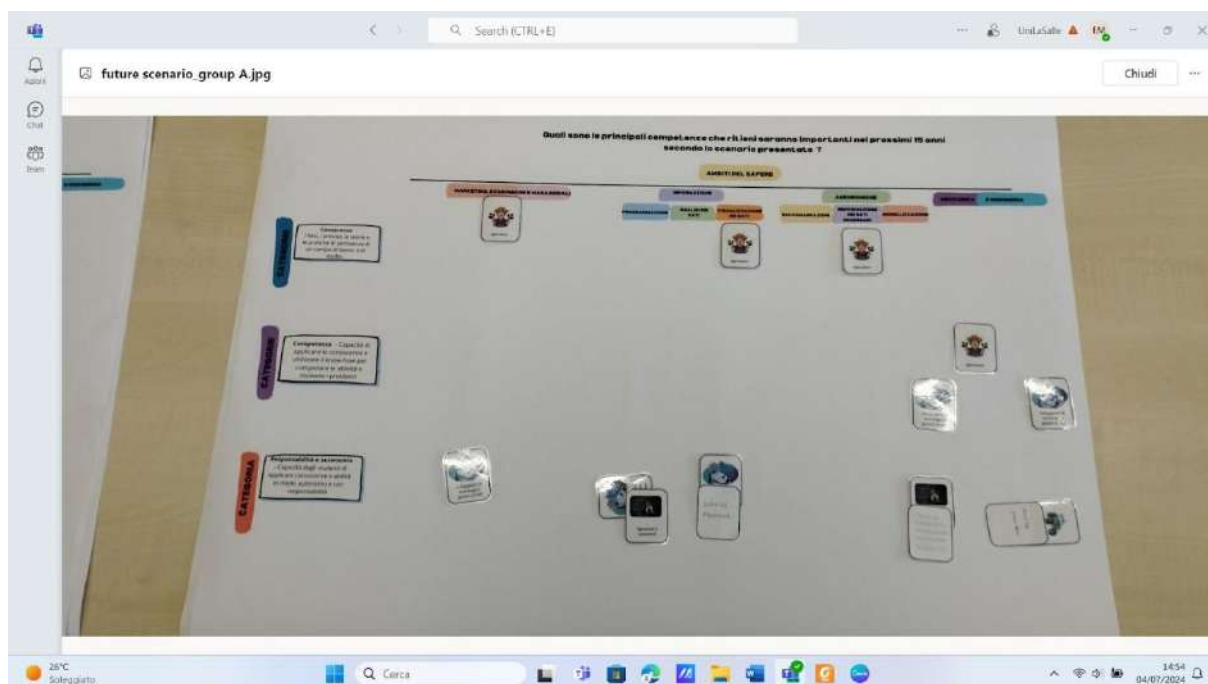
The machinery dealers will disappear because the "Service Provider" will cover also this activities.

Farmers remain as mere executors, they will have some skills in economic and business because the algorithm will give all the information.

The agronomist will be who knows how to interpret the data produced by artificial intelligence and will help the technology developers and will check the algorithm.

Results of group A:

Actors	Level of knowledge	Knowledge Domain
Farmers	Skills	Data visualization
	Skills	Economic, business and marketing
	Skills	Agronomy
Technology developers and data providers	Responsibility and autonomy	I.T.
	Responsibility and autonomy	Economic business and marketing
	Knowledge	Modelling
	Knowledge	Engineering
Agronomists and Consultants	Responsibility and autonomy	I.T.
	Responsibility and autonomy	Agronomy
Service providers	Responsibility and autonomy	Mechanic and Engineering
	Responsibility and autonomy	Data visualization



Group B.

In this group the participant decided as before the size of the Farm, it will be more than 100 ha.

In the future two new professional profiles will be necessary: the “Agrodeveloper” and the “Agroproducer”.

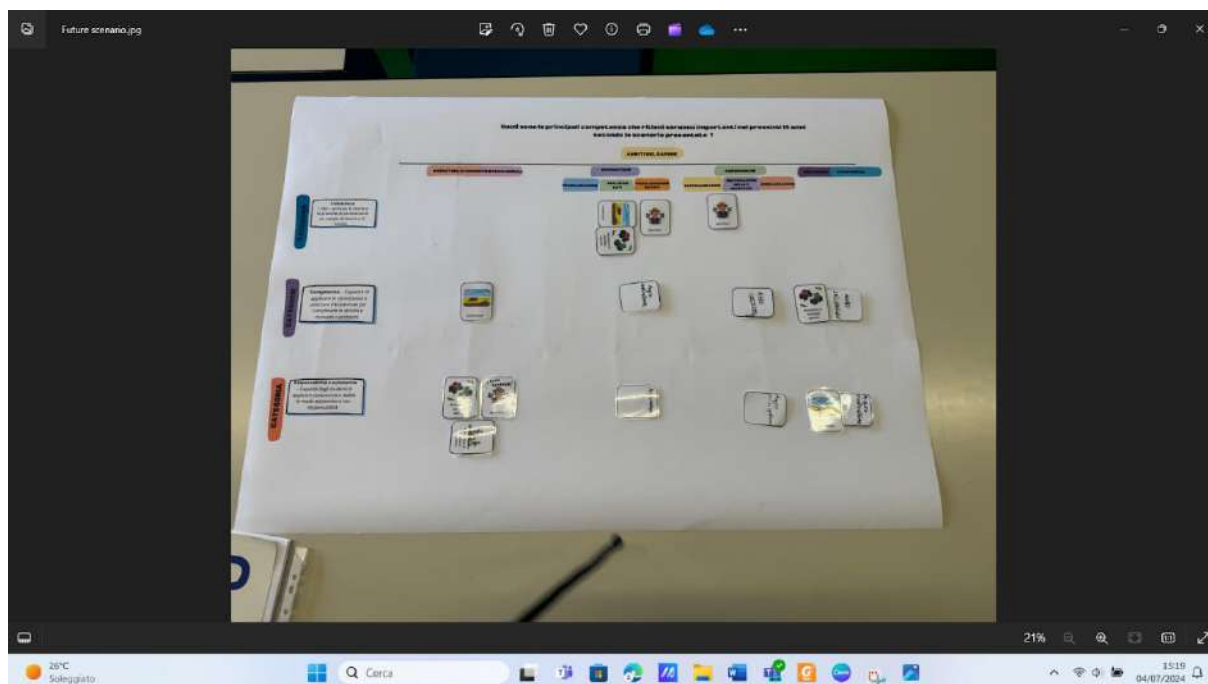
These two new profiles will be a sort of hybrid between the technology developer and the agronomist and the machinery producer and agronomist.

The Machinery dealers, the producers' associations and contractors will remain.

For some participants the matrix for the scenario must be updated with a new row with the ability to do things without knowledge.

Group B results:

Actors	Level of knowledge	Knowledge Domain
Farmers	Knowledge	Data visualization
	Knowledge	Recommendations and data needed
	Responsibility and autonomy	Economic business and marketing
Agrodevelopers	Responsibility and autonomy	IT
	Responsibility and autonomy	Agronomy
	Skills	Mechanic and Engineering
Agroproducers	Responsibility and autonomy	Mechanic and Engineering
	Skills	Agronomy
	Skills	I.T.
Contractors	Responsibility and autonomy	Mechanic and Engineering
	Knowledge	I.T.
	Skills	Economic and business
Producers' associations	Responsibility and autonomy	Economic business and marketing
Farm machinery dealers	Responsibility and autonomy	Economic business and marketing
	Skills	I.T.
	Skills	Mechanic



4. Conclusion – final discussion

At the end of the Focus Group all the participants agree about the necessity of a more involvement of Farmers and Contractors in the construction of machinery and in the process of technology development and more field training for the students. The importance of economy, management, and business skills will increase in the future. Furthermore, today, the agronomist must possess more economic competencies.

The other professional profiles must improve their competencies in mechanics and engineering.

5. Summary of the Focus Group

The discussion was highly engaging, and the participants were responsive.

The only weakness was the lack of professional profiles related to the Farm machinery producers and dealers. Furthermore, due to the weather conditions very rainy that affected the possibility to be in the field in late spring 2024, most of the invited farmers and contractors were unable to attend the Focus Group.

Some of the participants expressed interest in being involved in future activities of the project.

BOKU Focus Group Report

Organization name:	University of Natural Resources and Life Sciences, BOKU, Vienna
Time and date: (from ... to..)	18.06.2024 13:00 till 14:30 (CET)
Where was the focus group organized: (Location name or online)	Online
Total number of participants:	3
Number of participants group A: (farmers, contractors, association..)	1
Number of participants group B: (Farm Machinery Dealers -Farm Machinery Producers)	
Number of participants group C: (Technology developers and data providers)	
Other participants: (Uni. Professors, Phd,)	2, Student and Agronomist/Contractor

1. Welcome, presentation and warming-up

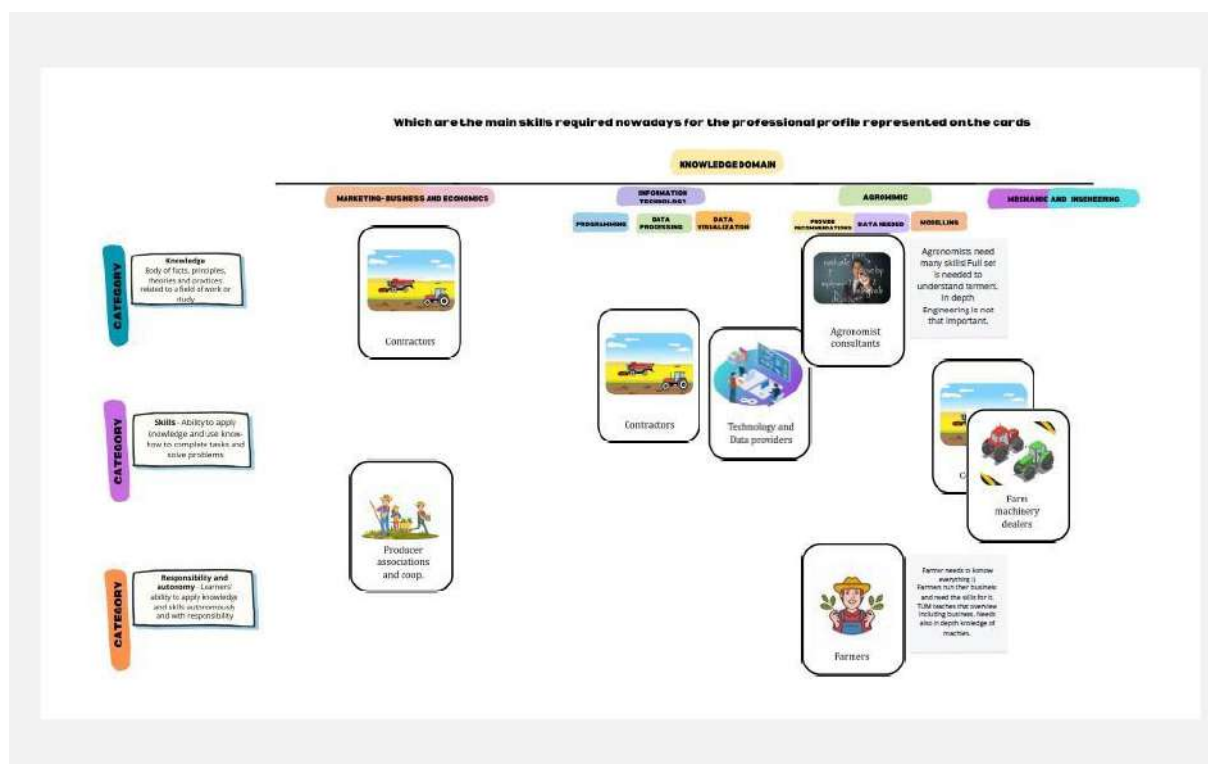
BOKU Team has welcomed and introduced themselves to the participants of the focus group. Vladana Vidric was the moderator and Martin Mayr technical assistant. The participants were informed about the focus group protocol and the personal data protection. Each participant has introduced their profiles, their companies, and had a chance to say something about their experience. In the focus group discussion, we had one farmer who has done the vocational training as a farmer and at the same time is a researcher for alternative powertrains in vehicles for the transportation of sugar beet and raw milk, master student for agriculture system science and worker at the department Chair of Agriculture TUM, and Agronomist who works at the tobacco company where he provides supervision in agronomy and makes the contracts with growers. The moderator has presented results of the PR 4.1 and asked the participants to give their own opinion about the results. One of the participants gave the feedback that he would need more time to go through the analysis and results and that according to what he saw he believes that the results were expected.

2. The current state of precision agriculture

Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

Add photo of the completed matrix (matrix with cards placed by the participants)

In this section Vladana Vidric has introduced the task, explained the cards and diagram and two rounds were completed. One of the participants selected agronomist card and explained that the knowledge category would be important for this profile. Generally, all participants had the common opinion that pointing only one category for one profile would not be enough. For example, for farmer would not be enough to do a data processing only but other skills such as negotiating or knowledge to do his field, about diseases, and how to run his business, calculations and to take decisions. The farmer would need a full set of skills. For Agronomist the opinion was the same. They also need a full set of skills to consult farmers. When it comes to consultant profile card, one of the opinions was they do maybe need a knowledge of type of the machine, but they do not need to know how the machine works. Card profile machinery dealer was pointed between Agronomic, and mechanic and engineering domain and between the knowledge and skills categories. Profile card contractor needs knowledge in information systems and knowledge and skills in marketing and economics. For producers the emphasise was given to the skills and responsibility and autonomy in the knowledge domain of marketing-business and economics. Technology and data provider profile card was pointed out for knowledge and skills in IoT and economic.



3. Future scenarios.

Focus group discussion development: brief description of the phases (relevant elements, problems, positive and/or negative aspects, difficulties)

4. Conclusion – final discussion

The level of skills needed in the whole agricultural sector will increase but it will shift between different roles highlighting inter and transdisciplinary collaboration. It will be dynamic and unexpected diffusion of profiles. The participants found the discussion very interesting but had a common opinion that this type of research is very difficult, and it is very difficult to predict what will be needed in 15 years when the current change in technology and regulations is fast and unpredictable.

5. Summary of the Focus Group

Overall impression about the focus group discussion

The participants found the discussion very interesting but had a common opinion that this type of research is very difficult, and it is very difficult to predict what will be needed in 15 years when the current change in technology and regulations is fast and unpredictable.

Overall impression about participants

The participants come from agricultural sector, industry and University. Some of them have already knowledge and experience in this domain of research, but some also were for the first time in this type of research. It was very easy to approach them.

How were the participants to the focus group: interested and reactive, collaborative, silent, passive, inactive, etc.?

The participants were very interactive and collaborative in showing their opinion and concerns giving us relevant information.

How did you feel as interviewer/moderator/assistant (concentration, external influences, ability to make participants join the discussion, etc.)?

As the moderator I have felt very relaxed since I have worked with some of the participants. It was easy to approach them and to gather relevant information. It was not difficult to lead the protocol and the participants were collaborative and exact.

Have you had any problem? (appointment cancelled, missing participants, interviewees/participants' reliability, technical problems, etc.)

Apparently, the focus group was set up for face-to-face meeting. Because of the illness of some participants and some other obstacles we had to change the date and to set up the online focus group.