Inclusive REskilling and upSkilling Toward competitive Agrifood and veterinary sector: European agenda Strategy

D2.1: Report on urgent skills needs per country and per sector	
Document description	This task aims at identifying urgent skills needs fostered by the COVID-19 crisis and the emerging technologies, green and digital transition for agri-food and veterinary sector.
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1. Introduction

The objective of the WP2 is to quickly cover the urgent skill needs at EU level and carry out in the first year of the project the initial pilots to have feedback with the training needs both from the workforce and business perspective, keeping in mind the Green Deal, the Farm to Fork, the new CAP EU initiatives and actions to address the COVID-19 crisis.

Since the I-RESTART aim is to provide inclusive and innovative training, the pilots will be led by VET providers and stakeholder associations in 'AgriFood Industry Open Days' at the food processors/farm level, that will occur possibly in the same   month of the year, to allow massive dissemination event.

The AFI Open Days will be organised by Agri-food and Food Industry Federations during their daily own main events - either internal such as Assemblies and Committees or external such as Conferences, Innovation Awards/Prizes, Trophelia, International Fairs (Anuga, Sial, Cibus, Alimentaria ,...) - with the aim to present their best practices but also to host the pilots/workshops with the help of the trainers and the experiences of the agri-food chain operators/companies. The participant will fill in the survey on skills from WP3.

The skills that will be proposed during the design phase of the pilots will be chosen in these areas, suggested by I-RESTART partners:

Digital tools, digital marketing, cybersecurity, AI, website build, e-commerce platform, e-mailing campaign know-how, sales strategy, exports, new aspects in food safety, technology, processing, logistics, quality control, process optimization, engineering, auditing, animal wellness, veterinary activities, the food system, agriculture policy, circular agriculture, biodiversity, future farming, minerals cycle and accounting, regional/national programmes and subsidies, entrepreneurial mindset and effectuation, opportunity recognition, business modelling for impact-driven ventures and entrepreneurial finance.

1.1.   Aim of task 2.1 Identification and validation of urgent skills

This task led by INFOR aims at identifying urgent skills needs fostered by the COVID-19 crisis and the emerging technologies, green and digital transition for agri-food and veterinary sector.

INFOR, COPA-COGECA, FDE and EIT FOOD, with the support of all partners will select skills and knowledge that need urgent up- and re-skilling. This quick study will be based on available outputs from the Skills Panorama platform from CEDEFOP which integrates in one single portal data and information on skills needs and mismatches from EU, the ESCO database, the AER roundtable of April 2021, the EIP-Agri seminar on digital skills, the IOF2020 project (AARHUS, WUR) and all useful inputs from partners previous or on-going project on the subject (FIELDS, PLANET, SAGRI, ASKFOOD, FIT4FOOD, ….)

The output will be in the form of microcredentials, that require only one day to be learned, considering that the main target of the action, in this phase, will be the already employed people. Depending on the subject the EQF level of the pilot will be 4-5 or 6.

The topics discussed by the partners, offered at very introductory level are listed here: Digital tools, digital marketing, cybersecurity, AI, website build, e-commerce platform, e-mailing campaign know-how, sales strategy, export, new aspects in food safety, technology, processing, logistics, quality control, process optimization, engineering, auditing, animal wellness, veterinary activities, the food system, agriculture policy, circular agriculture, biodiversity, future farming, minerals cycle and accounting, regional/national programmes and subsidies, entrepreneurial mindset and effectuation, opportunity recognition, business modelling for impact-driven ventures and entrepreneurial finance.

For this purpose, the project will assess the skill needs in the animal production, food industry and veterinary sectors, in the following areas:

- Digitalisation
- Sustainability and bioeconomy
- Business and entrepreneurship
- Soft skills
- One-health
- Sector specific emerging trends

2. Pan-European Focus Group Analysis

2.1. Most important skills at European level

In the Pan-European Focus Groups (FG) organised during the FIELDS project in May-July 2020, as a preliminary exercise previous to the FG conduction, participants were requested to check the 5 skills lists, each one related to different skills categories: sustainability, digitalisation, bioeconomy, soft skills and business-entrepreneurship skills. They had to select and rank the 5 most important skills for each category, leading to the selection of 25 skills. In a second step they had to rank, from the 25 skills, those 10 most important skills for them, resulting in a ranking with skills coming from different categories. 95 participants carried out the 10-ranking exercise properly, and their data were used for the national and European analysis. During the FG, all participants were asked to present their top 10 rankings and each participant was requested to present his/her 3 most important skills in a reasoned manner. In this section only results at European level are presented. Figure 1 shows the most selected skills at European level.
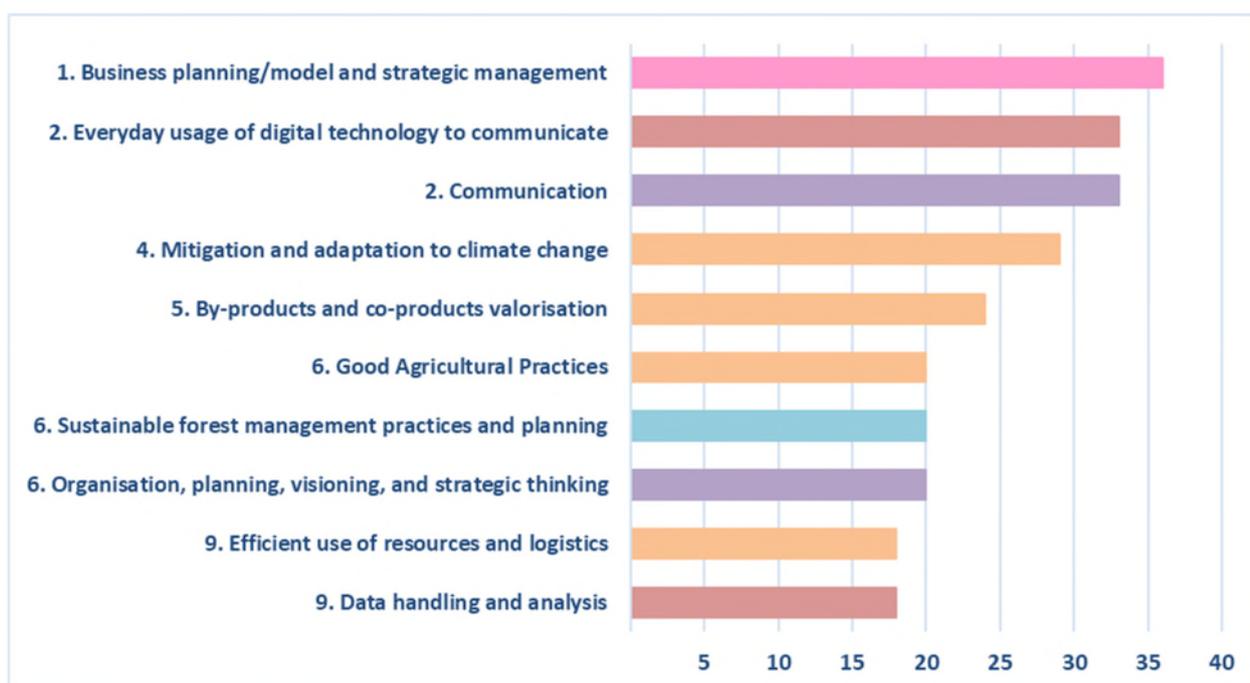
Figure 1 Most selected skills at European level [n=95]

Looking at Figure 1, the most selected skill was *business planning /model and strategic management* followed by two skills related to communication: e*veryday usage of digital technology to communicate* and *communication* (both the same number of selections). After that, three skills from the sustainability category:

mitigation and adaptation to climate change, *by-products and coproducts valorisation* and *good agricultural practices* were selected. The only bioeconomy skill among the 10 most selected, but also related to sustainability was *sustainable forest management practices and planning*, followed by *organisation, planning, visioning and strategic thinking (*soft skill), *efficient use of resources and logistics (*sustainability skill) and *data handling and analysis* (digital skill).

It is interesting to note that skills related to management/planning, sustainability, digitalisation, and communication predominate in this list. Furthermore, it is evident that bioeconomy skills related to the food industry and agricultural sector do not predominate the selection, but rather that the non-technical skills on sustainability, business and entrepreneurship skills, digital skills and soft skills all have a fair share of the predominating skills. When looking at the whole picture (Figure 2), there is not clear evidence on a predominant skills category among the selected skills.

Figure 2. Distribution of skills among the categories

2.2.   Most important skills by categories and sectors
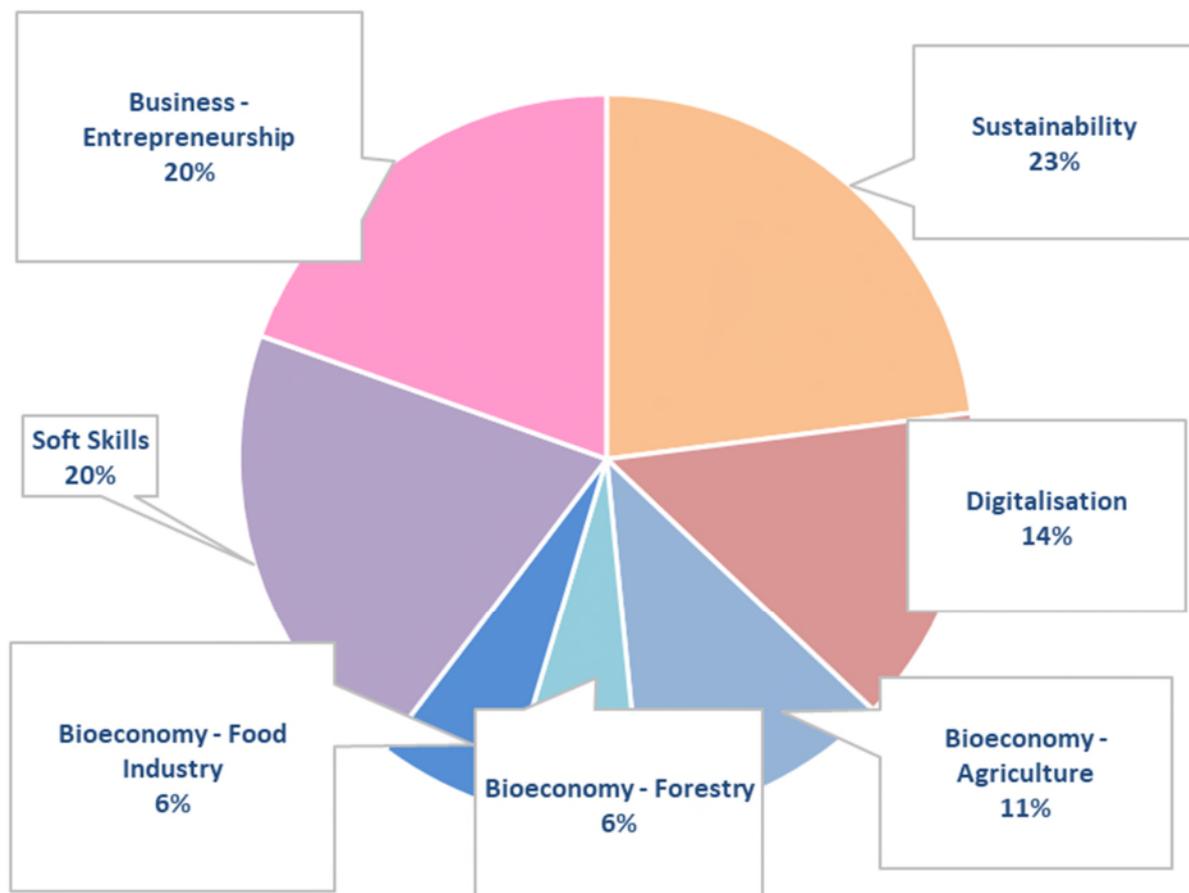
Brief summaries for the first three skills in each category are given below.

2.2.1.   Sustainability skills
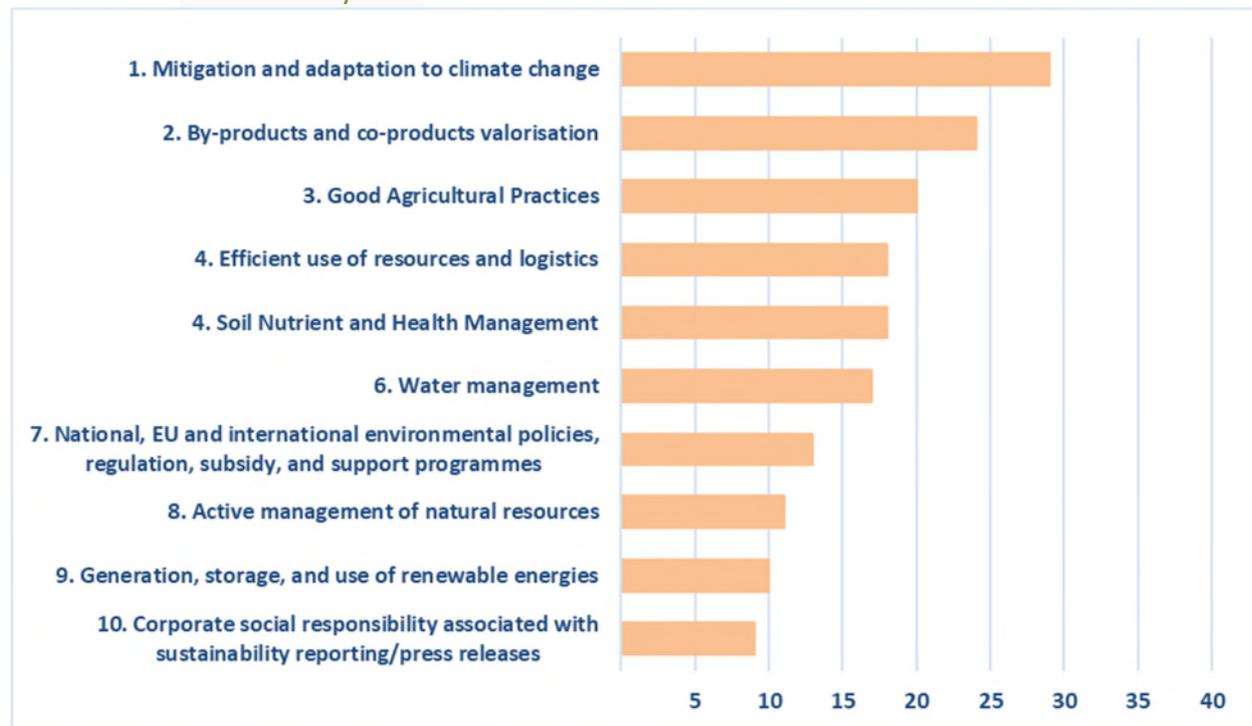
Figure 3. Most selected skills for the sustainability category [n=95]

- *Mitigation and adaptation to climate change*. This skill appears as the most important sustainability skill for participants, not only for a more sustainable and adaptable agriculture, but also to learn to communicate to society that the agricultural sector is already a key factor in environmental sustainability.
- *By products and co-products valorisation*. Very important in the context of a circular economy, resources efficiency and conservation. Their use as an energy source or to make something innovative to bring to the market. It is also seen as an opportunity for creating or relocating jobs.
- *Good agricultural practices*. In terms of sustainability, but also in terms of solving day-to-day problems in farming operations. Also, the normative aspect of these practices was noted as a market requirement.

2.2.2.   Soft skills

- *Communication*. It is the second most selected skill in general, and the first within soft skills. Communication at different levels: among day-to-day collaborators, between different producing sectors in the food and forestry chains and with consumers and society in general.

- *Organisation, planning, visioning, and strategic thinking*, in order to change our mindset and not only focus on the present but also to be able to think strategically and plan at the middle and long-term.
- *Analytical, critical, and creative thinking*. For new employees, to decipher between what is learned in school/university and the real world; and for everyone attempting to adapt to the current and future challenges of the agri-food and forestry sectors.

Figure 4. Most selected skills for the soft-skills category [n=95]

2.2.3. Business-entrepreneurship skills

Figure 5. Most selected skills for the business-entrepreneurship category [n=95]

- *Business planning/model and strategic management.* It is the most selected skill, considering all the skill categories. Start from the basis of understanding business, the role of the company, its viability, how

value and profit are generated. To be prepared to adapt our business to the current and future challenges (mainly sustainability but not only), whatever the size of the company, small, medium, or large

- *New value chains/new business models.* What these new chains/businesses may offer to the farmer/forester and how these are related to bioeconomy, conventional and novel agricultural practices.
- *Project management*. It is a skill that was mainly selected by educators and researchers, but also by advisors and farmers.

2.2.4. Digitalisation skills
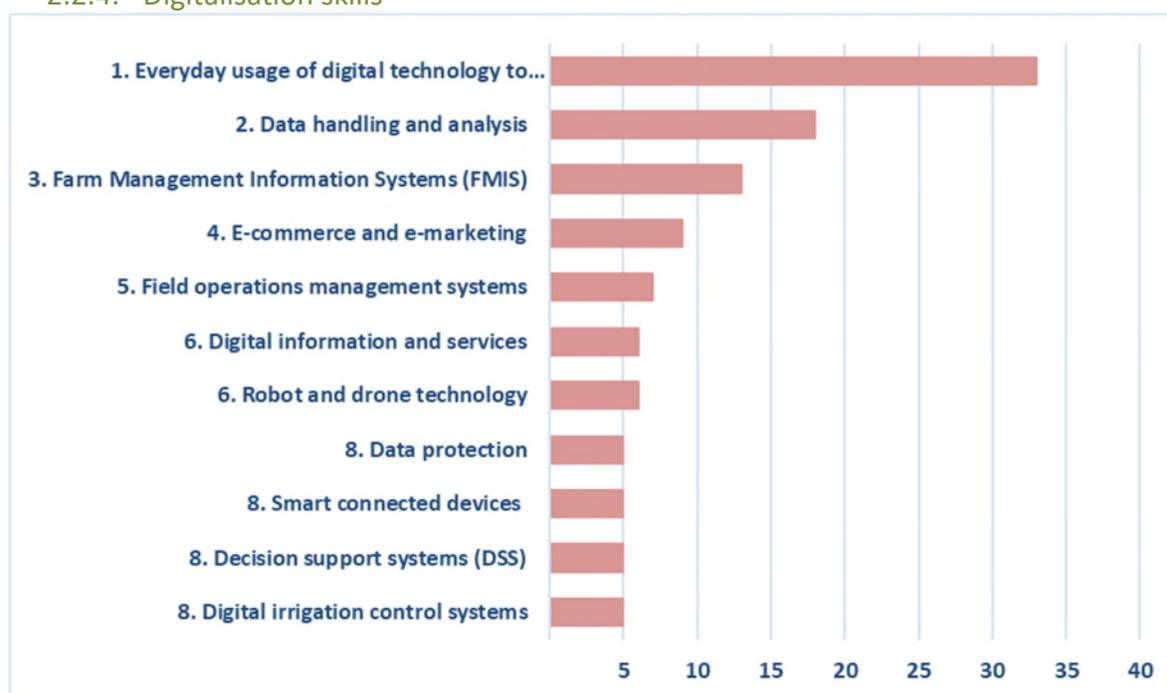
Figure 6. Most selected skills for the digitalisation category [n=95]

- *Everyday usage of digital technology to communicate.* It is the second most selected skill in the top 10 rankings. Digitalization is here to stay; it is everywhere and as a communication tool is a basic step to be accomplished before acquiring more demanding digital skills.
- *Data handling and analysis*. Not only the technical aspects related to it, but also other related issues such as GDPR, ethical issues, etc. Awareness of the strong potential that data handling and analysis may have in agriculture and forestry.
- *Farm management information systems*. It highlighted the potential of sharing data in combination with farm management information systems to improve the management of farms.

2.2.5. Bioeconomy skills

- *Sustainable forest management practices and planning. Because its relation to other topics, such as biodiversity and because policy trends for more strict forest regulations on sustainability. From another point of view, sustainable non-timber forest products for an innovative forest industry.*
- *Planning and coordinating production,* for the proper functioning of the business. It is also seen as a basic pillar for the agri-food entrepreneur.

Figure 7. Most selected skills for the bioeconomy category [n=95]

- *Conventional vs. organic farming*. What these farming approaches, single or combined, can offer in terms of innovation. Also, organic farming is part of the whole sustainable farming system.
- *Quality management, quality assurance and quality control.* Always important for the agri-food companies. It was also selected in the top 10 for 2 cooperatives.

Figures 8 through 11 show the most selected skills for the related stakeholder profiles. It is interesting to note that the number of sustainability skills decrease in the sequence farmer-cooperative-industry, whereas business skills increase.

2.3.   Missing skills

Following from the first exercise in the focus groups, the next question participants were asked was if they would add any missing skills in the lists and why this skill/these skills are important. It is worth noting here that in some focus groups the discussion turned to focus not only on those skills missing in the provided lists but in general of the agri-food and forestry sector.

Generally, for farmers, mainly soft skills and sustainability skills were mentioned as missing skills. And one soft skill mentioned as missing, is the skill *time management*. Another skill, which is closely related to the umbrella term communication, is *communication and engagement with civil society* and related to the ability to exchange knowledge and to be confronted with civil society which was mentioned. Also related to engagement and communication is the skill mentioned as *"Connecting /communication with consumers and market"*. This skill was also emphasised by representatives of agri-food-companies who mentioned that this skill is lacking for farmers, both the collaboration between farmers for marketing and management purposes but also for sustainability purposes to decrease waste and promote circular production (agri-food industry).

As regards sustainability skills, the missing skills mentioned were water use and in this connection the *management of groundwater*. The topic of water use was mentioned also in relation to *legislation*

regarding the issue of water. Especially the topic of skills related to *rural biodiversity and synergies in the environment* were mentioned by farmers.

For representatives of agri-food companies regarding bioeconomy skills, "*process engineering*" was added by an agri-food company representative. In relation to business and entrepreneurship skills, *lean management* was mentioned as a lacking skill.

For industry representatives, the soft skill of *"Connecting /communication with consumers and market"* was mentioned as a missing skill, similar to farmers. Other soft skills were *the "Concept of influencing"*; the *"Integration of competences/skills"*; "*systems thinking*" and "*facilitation skills*".

"*Product life-cycle management and thinking*" was mentioned as a missing skill. As a general remark, a representative from a governmental agency in the Spanish-Portuguese Focus Group mentioned that: *"returnable, reusable, recyclable, compostable, with recycled content from lower weight renewable materials, with low energy consumption*" (govern. agency, 38132) should be added to the topic of sustainable packaging. Another general remark from an education provider was the ability to adapt and to change specialisation.

Another skill mentioned several times, especially by education providers, but also by other stakeholder groups is the ability to connect or to integrate skills and competences.

The participants of the Policy focus group, in concordance with previous comments, indicated *communication with consumers* (environmental and social sustainability, risk management) of paramount importance to increase their trust in the agri-food sector. A participant indicated that there are so many agriculture and food options that consumers have started to question their quality, safety and particularly sustainability. In this context, new skills and competences (more in the commercial than in the technical side) should be developed to inform the public on those aspects. As far as sustainability is concerned, more awareness regarding food waste faces two issues: the need to avoid food waste, for example by providing better knowledge about the best before date information; and better consumer knowledge on how to properly dispose of unwanted food.

2.4.   Change of skills

To question 2.3 - How do you think your current top ten list will change within the next 5-10 years? Will there be other skills in the list? Or will the ranking have changed? - in several of the focus groups, there was general agreement that such skills lists will constantly change in response to external factors.

Nevertheless, while in Greece, some participants were of the opinion that digitalization has been idealized and that there are more pressing challenges, such as water management, in Ireland several participants highlighted digitalisation as a key future skill, where specific emphasis was placed on Precision Agriculture (precision animal health, precision soil and nutrient control), Lean, Mechanical Operations and both Electronic and Robotic Automation, as well as Artificial Intelligence.

In Spain-Portugal, Ireland and Slovenia, many participants agreed that the area of sustainability will be a core future skill needed, as highlighted by an Irish agri-food representative. In particular, sustainability of the food system, climate change mitigation and efficient use of resources will be emerging topics in the near future.

Participants agreed on three sets of skills for the future:

- Technological skills: digitalization of processes and data management, application of IoT and distance working.
- Sustainability skills: efficient use of resources (especially water), risk management (including disease prevention), but also the ability to restore forests.
- Social Skills: effective communication in a view of conflict management and the building of interlinks with the communities. On a broader scale, the understanding of global trade dynamics and the Chinese language.

3. Identified Skills (both future & current)

Both Current and Future Skills Need results were analysed to ensure consistency between the skills needs identified in the focus groups and also as a check to ensure that no skills needs were overlooked. The analysis of the skills needs was conducted at European level, sectoral level as well as at country levels in order to get a holistic view of skills development and any potential gaps that may exist. The skills assessment was conducted in line with the identified skills categories across the project as follows:

1. Sustainability Skills
2. Digitalisation Skills
3. Bioeconomy Skills (Agriculture)
4. Bioeconomy Skills (Food Industry)
5. Soft Skills
6. Business and Entrepreneurship Skills.

The assessment of skills was conducted firstly on the basis of identifying the importance of a particular skill and secondly whether a particular skill needed to be trained.

3.1. European Level

The initial review of skills was conducted at European level across the afore-said skills categories. The collective results are outlined below:

Sustainability Skills

Mitigation to climate change, efficient use of resources and logistics and good agricultural practices were identified as the prominent skills requirements within the sustainability arena and were identified as being absolutely essential or very important. Interestingly, it was also clear that these particular skills could be learned through training.
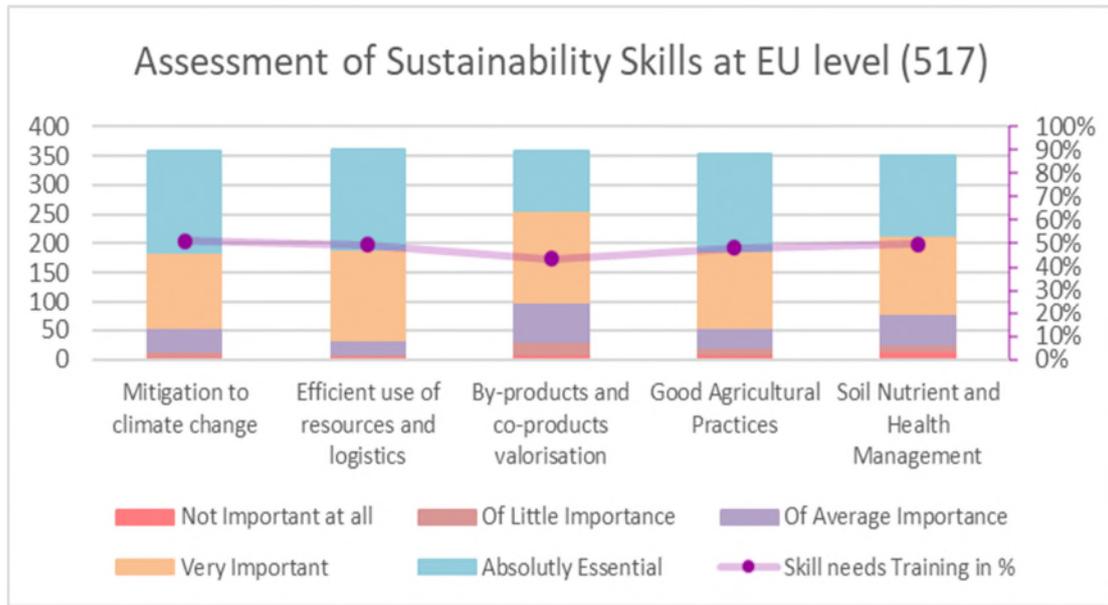
Figure 8. Assessment of Sustainability skills at EU level (n= 517)

Digitalisation Skills

Collective results indicate that digitalisation skills across Europe are fragmented but are either very important or essential in the current environment. There appears to be a high demand for digital technology as a communications tool and for data analytics, followed closely by farm management information systems (FMIS). From a training perspective, it was clear that both data analytics and FMIS required additional training.
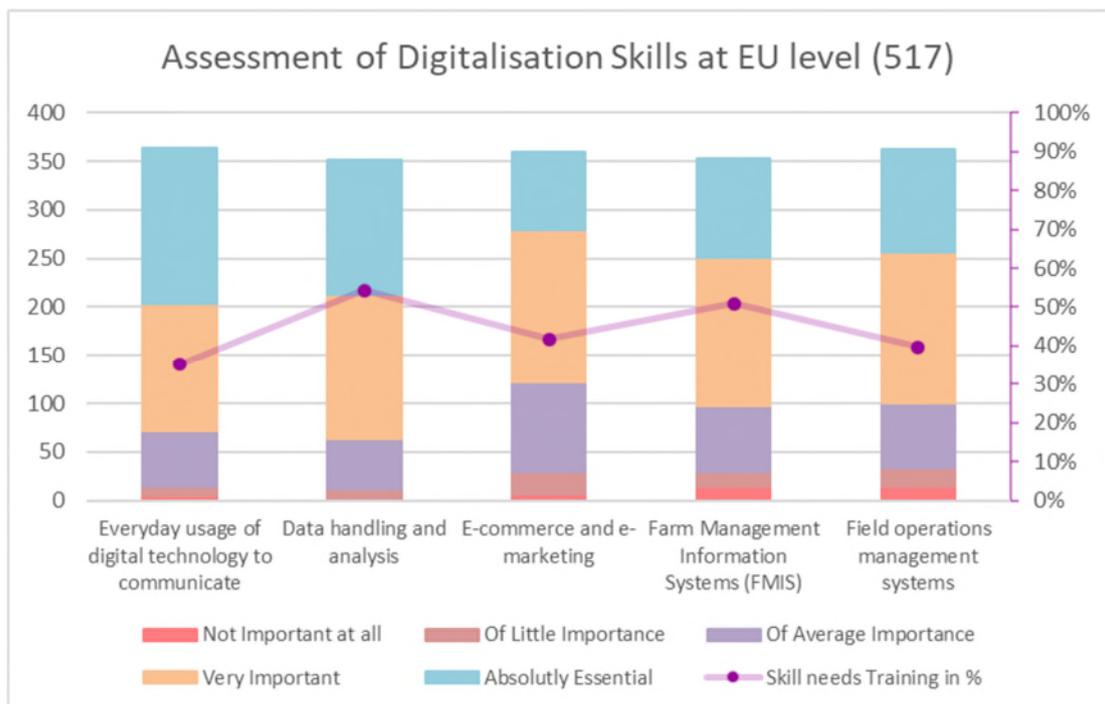
Figure 9. Assessment of Digitalisation skills at EU level (n= 517)

Bioeconomy Skills

The bioeconomy sector is vast and there appears to be a lot of uncertainty around practical bioeconomy skills and exactly what is meant by the bioeconomy sector, across agriculture in general. Whilst this is a relatively new sector, it is clear that greater inroads have been made in the bioeconomy sector within the food industry and across the agriculture sectors, respectively.

Bioeconomy Skills – Agriculture

The results of the survey clearly shows that planning and the coordination of production and performing farm operations is absolutely essential or very important. It should be noted, that when considering if a particular skill required training, the results were more disjointed with almost 50% of respondents saying that calculating, handling and managing risk, was the skill that required the most training.
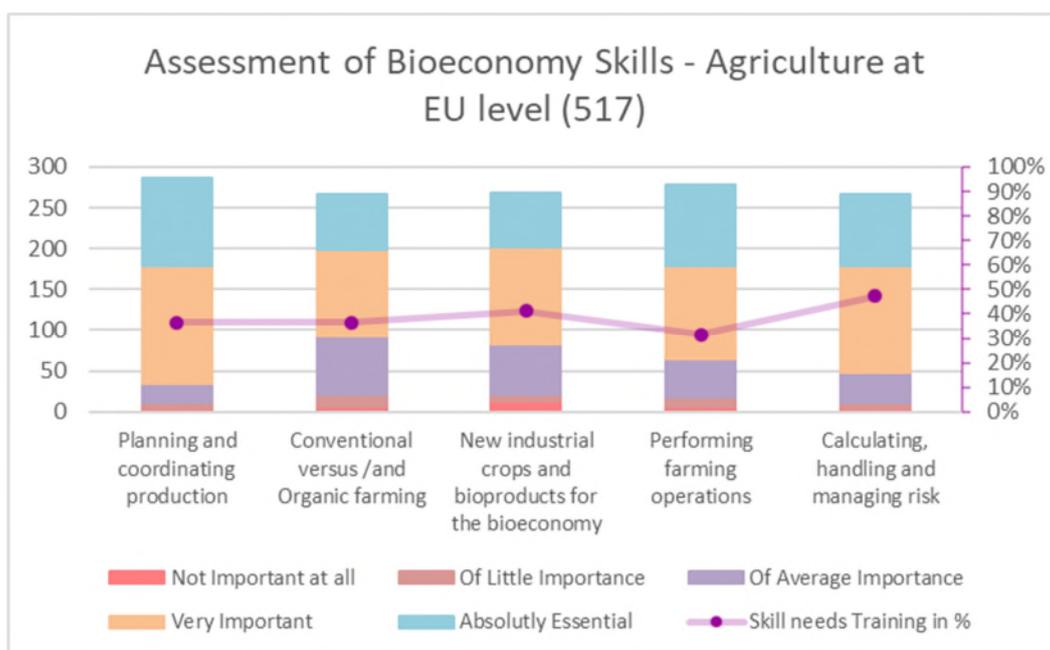
Figure 10. Assessment of Bioeconomy – Agricultural sector skills at EU level (n= 517)

Bioeconomy Skills – Food Industry

There was a clear catalytic approach to the bioeconomy across the food and co-operative sectors, with a huge focus on quality management, quality assurance and quality control, food safety management, food hygiene and food safety controls. Similarly, food security also ranked high on the skills agenda. It should be noted that this particular industry is very compliance driven, which could attribute the way in which skills were identified. Interestingly, all three of these skills could also be learned through training and are required to be trained.
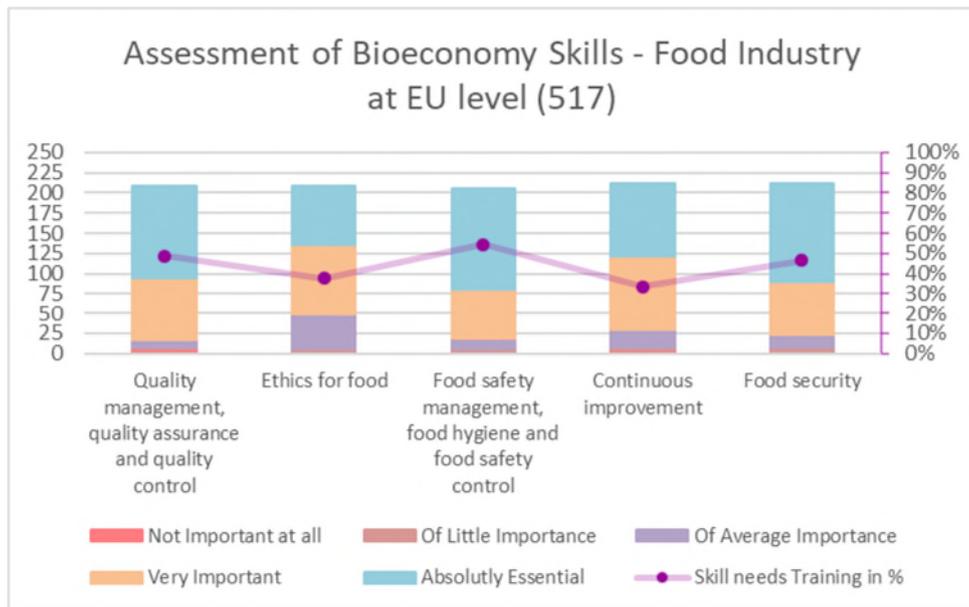
Figure 11. Assessment of Bioeconomy – food industry sector skills at EU level (n= 517)

Soft Skills

The results of the survey identified soft skills as being essential and very important across the board. From a learning perspective the skill that was identified that mostly needed to be trained, was organisation, planning, visioning and strategic thinking. Soft skills are a collection of positive attributes and competencies that can improve work performance and productivity, enhance relationships, that make individuals and businesses more marketable.
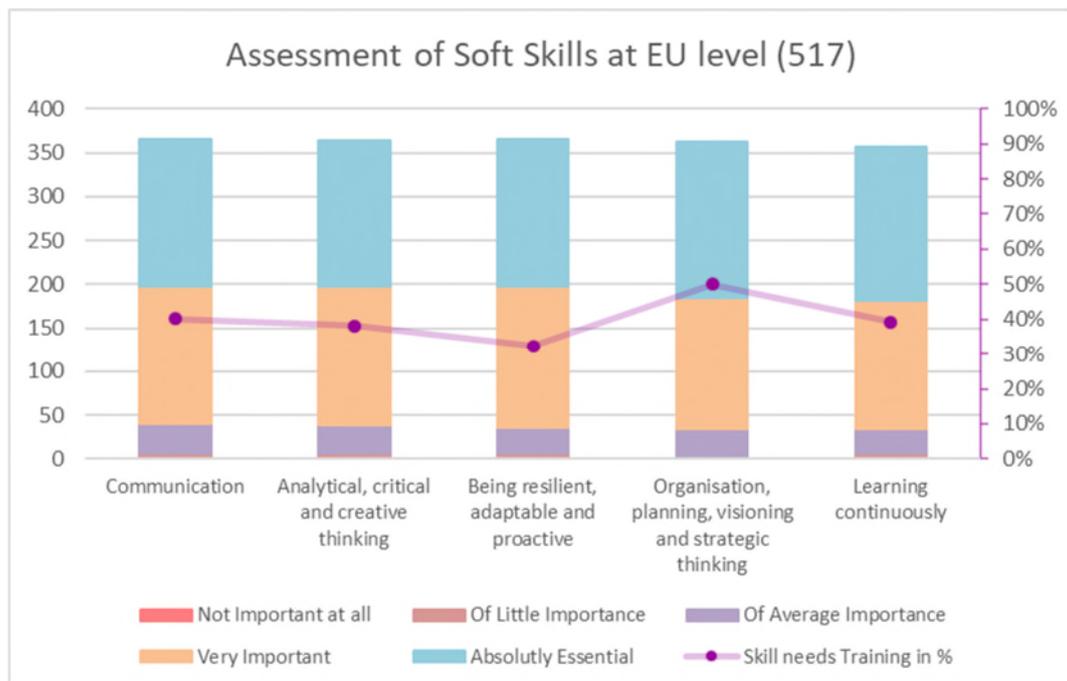
Figure 12. Assessment of Soft skills at EU level (n= 517)

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Business & Entrepreneurship Skills

Business and entrepreneurship skills ranked high across the identified skills lists, with all skills being ranked as absolutely essential or very important. However, training in these skills ranked of average importance in the overall European framework. What was noticeable is the need for training in relation to business planning/model and strategic business management.
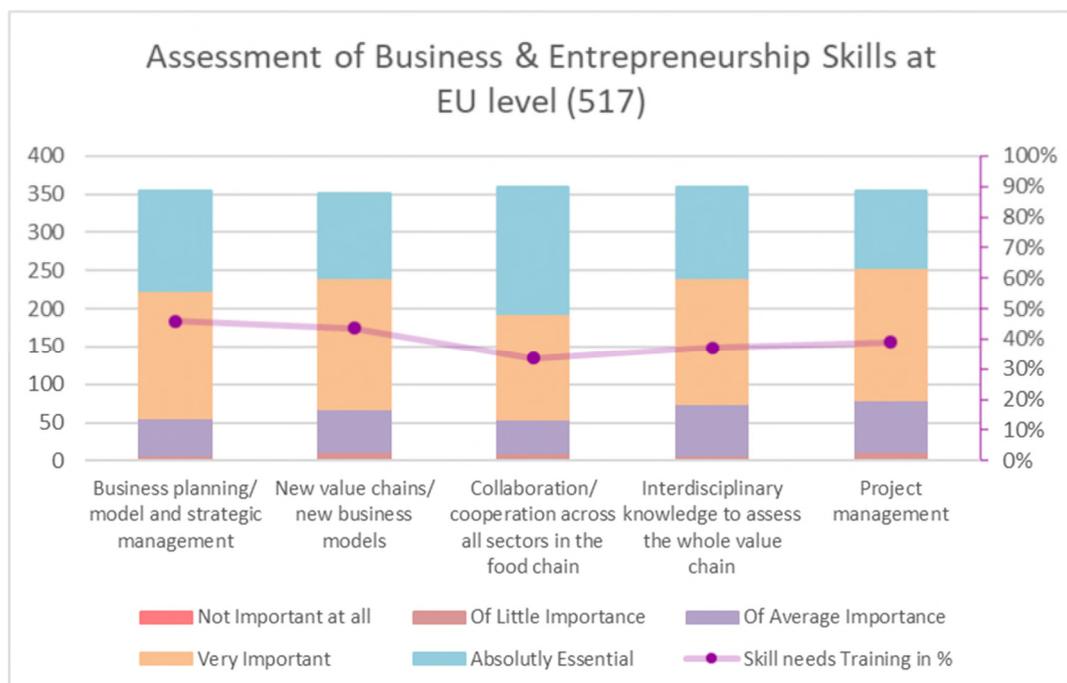
Figure 13. Assessment of Business and Entrepreneurship skills at EU level (n= 517)

3.2.   Sectoral Level

Whilst the previous section outlined the overall European skills needs by skills category, we needed to understand what the skills needs might look like, considering the various stakeholder profiles, operating across the various sectors within the overall agricultural sector. Once again, we approached this task by skill category linked to the stakeholder profiles. The profiles considered are as follows:

1. Advisors
2. Agri-Food Companies
3. Co-operatives
4. Education Providers
5. Farmers
6. Other
7. Cross Sector Profiles

Sustainability Skills

Sustainability appears to be high on the agenda across all stakeholder profiles operating across industry. The top skills across all profiles were the efficient use of resources and logistics and good agricultural practices. Interestingly, all stakeholder profiles felt the top skill that needs to be trained was mitigation to climate change. This closely linked the training needs and skills and competencies, to policy and both EU and National levels across all participating countries.

Figure 14. Assessment Sustainability sector skills at EU level divided per categories

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Digitalisation Skills

A common theme across all stakeholder profiles was the need for everyday usage of digital technology to communicate and the need for data handling and data analytics, when considering digital skills needs. Overall digital skills needs were prominent for advisors, agri-food companies, co-operatives, education providers, farmers, and for cross sector stakeholders. However, co-operatives and education providers topped the list in seeing digital skills as essential and very important.
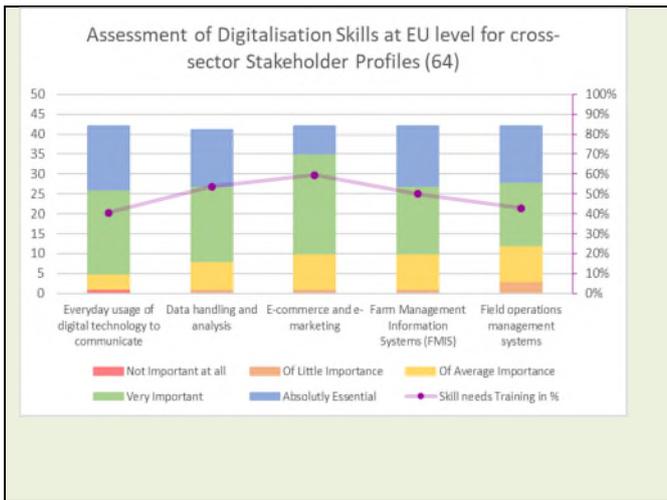
Figure 15 Assessment Digitalisation sector skills at EU level divided per categories

Bioeconomy Skills

The bioeconomy skills categories for stakeholder profiles were broken into two separate sub-categories: Agriculture and Food Industry.

Bioeconomy Skills - Agriculture

Similar to the European analysis, the bioeconomy stood out as a definitive need in the agricultural sector. However, the understanding of the importance of bioeconomy skills needs varied between the stakeholder profiles. Co-operatives and education providers, appeared to identify the most with the bioeconomy skills in agriculture, with particular focus on planning and coordinating production. Farmers on the other hand had more of a focus on performing farm operations. Advisors, other and cross sector stakeholder profiles had a more balanced approach to bioeconomy skills in agriculture.

Once again, the skill that stood out across most stakeholder profiles that needs to be trained was calculating, handling and managing risk. The differences in the recognition of bioeconomy skills in agriculture, can potentially be attributed to the wide range of operational areas across the sector.
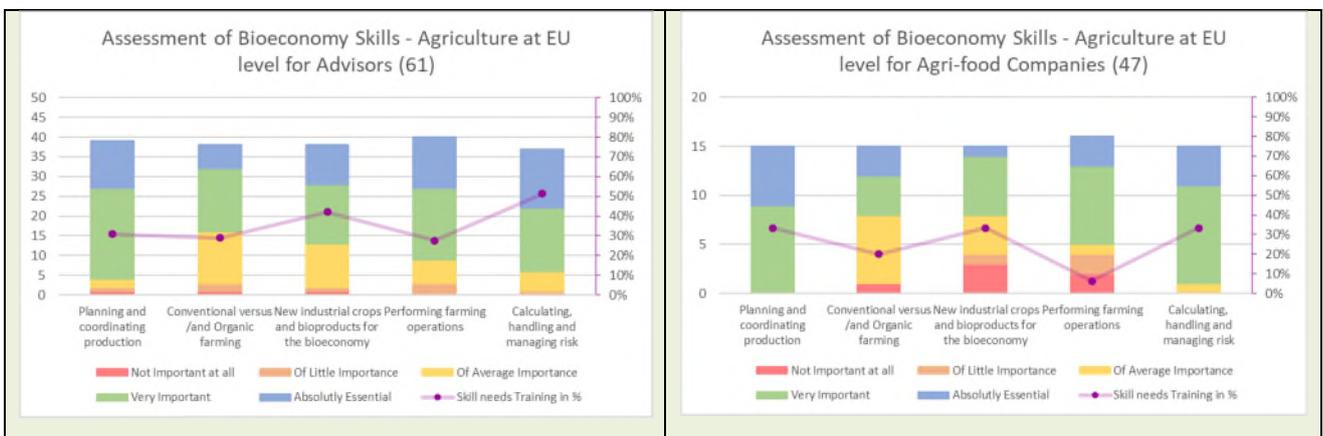
Figure 16 Assessment Bioeconomy - agriculture sector skills at EU level divided per categories

Bioeconomy Skills – Food Industry

The bioeconomy across the food industry was unanimously overriding across all stakeholder profiles. Considering the skills across this category, the skills that presented as the most sought after, were food safety management, food hygiene and food safety controls, food security, quality management, quality assurance and quality control. Once again this was not surprising, considering the high demand of compliance across the food sector.

The demand for training across all of the identified skills was viewed differently by each of the stakeholder profiles, although the demand for each of the learned skills was relatively moderate across each profile.

Figure 17 Assessment Bioeconomy – food industry sector skills at EU level divided per categories

Soft Skills

Interestingly, there was no differentiation between stakeholder profiles, when considering the importance of soft skills. All profiles identified soft skills as being absolutely essential or very important, across their areas of operation. This further supported the findings identified at both European levels and country levels and reaffirmed the attributes and competencies needed to improve work performance and productivity, enhance relationships, to make individuals and businesses more marketable.

All profiles identified that all the skills could be learned through training, and once again the skill that stood out the most in relation to training, was organisation, planning, visioning and strategic thinking, followed by communication and the need for continuous learning.

Assessment of Soft Skills at EU level for Advisors (61)

Assessment of Soft Skills at EU level for Agri-food Companies (47)

Assessment of Soft Skills at EU level for Cooperatives (45)

Assessment of Soft Skills at EU level for Education Providers (157)

Assessment of Soft Skills at EU level for Farmers (65)

Assessment of Soft Skills at EU level for Foresters (8)

Figure 18 Assessment Soft skills at EU level divided per categories

Business & Entrepreneurship Skills

All stakeholder profiles recognised the need for business and entrepreneurship skills across all five identified skill-sets. Equally, all skills-sets were seen as being absolutely essential or very important across all of the skills profiles. The skill that featured the highest demand across the food chain, was the need for collaboration and cooperation across all sectors of the food chain. This was followed by interdisciplinary knowledge to access the whole value chain and business planning/model and strategic management.

The skill that commanded the most training, to be learned, was business planning/model and strategic management. No one stakeholder profile stood out as requiring more training in business and entrepreneurship skills above another.
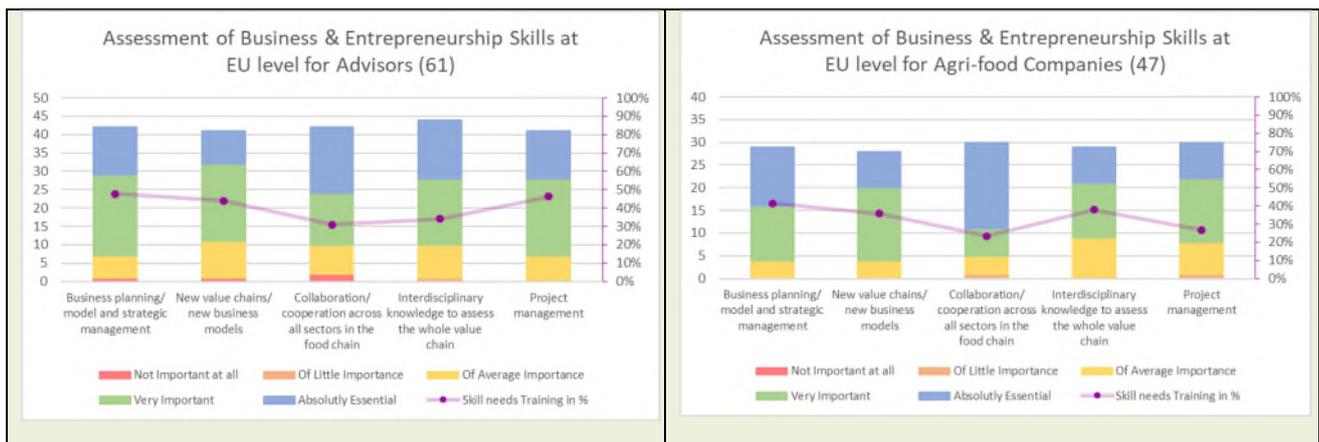
Figure 19 Assessment Business and Entrepreneurship skills at EU level divided per categories

3.3. Country Level

Additional analysis of skills needs was conducted at country level to benchmark the skills requirements. Below is a high-level outline of the findings for each of the skills categories across the following countries:

1. Austria
2. Denmark
3. Germany
4. Greece
5. France

6. Italy
7. Portugal
8. Netherlands
9. Slovenia
10. Spain

Sustainability Skills

There is a high need for sustainability skills as identified across all the relevant countries, although there are unique nuances pertaining to specific skill sets within each country. Training across the sustainability skills category was also fragmented as was the classification of whether a particular skill could be learned through training.

Digitalisation Skills

Everyday usage of digital technology to communicate was ranked as one of the most sought-after skills in the digitalisation category, although the levels of importance varied from county to country. Training and the relevance of whether a skill could be learned through training was also incoherent across countries, however, the majority of countries felt that data handling and analytics could be a learned skill.

Bioeconomy Skills

Planning and coordinating production were the most ranked skills in the bioeconomy (agriculture) skills category. Sustainable farm management practices and planning was the most ranked skill in the bioeconomy category and food safety management, food hygiene and food safety controls was the most ranked skill in the bioeconomy (food industry) skills category.

The idea that a skill could be learned was very dispersed across the countries, across all bioeconomy skills categories.

Soft Skills

In the soft skills category, the most identified skills were communications and organisation, planning, visioning and strategic thinking. It was noticeable that soft skills are a definite need in the people development landscape and that the learning of these skills was once again fragmented across countries.

Business & Entrepreneurship Skills

Business planning, modelling and strategic management, as well as collaborating and cooperation across industry sectors in the food chain were the skills that dominated the business and entrepreneurship skills category. Training in business skills was diverse from country to country with no one particular skill leading the way.

4. Scenarios analysis

Scenarios describe possible futures (based on an internally consistent set of assumptions about key trends and their interrelationships (Trienekens J. et al 2021). The scenarios should be plausible, meaningful, consistent across trends and regions, and relevant for multiple stakeholders. Scenarios should reflect maximum internal and minimum external cohesion. Scenarios do not predict but explore possible future pathways. Our scenarios aim to capture uncertainties in major socio-economic, technological, political and environmental trends in European Agri-food and Veterinary sectors. For this, we lean on the trend analyses on European and country level. The scenarios may be used to inform integrated assessment of agri-food and veterinary sectors, stimulate and guide research and public debate and facilitate policy making, enabling adaptation as well as transformation, on both European as well as on national level.

For the scenario analysis, we build largely on a number of scenario development exercises by EU researchers in the past decade. Important studies include the scenarios used in the framework of IPCC AR5, called Shared Socioeconomic Pathways (SSP) (O'Neil *et al.*, 2014, 2017), recent Horizon2020 projects building on these scenarios, like the SureFarm project, the TransMango project (Vervoort *et al.*, 2016), EC Food Safety and Nutrition scenarios (Mylona *et al.*, 2016), Agrimonde-Terra (Land use and Food security) scenarios (Mora, 2016), and a recent academic study integrating results of various scenario studies based on the SSPs (Mitter *et al.*, 2020). Further, we include an AKIS-SCAR scenario analysis (Poppe *et al.*, 2016), as this study includes possible development pathways of the European knowledge and information system

The 3 scenarios on EU level developed in this report take as a starting point the scenarios identified by Mitter *et al.* (2020) to be enriched by the other scenario studies mentioned above, also including the AKIS SCAR analysis.

The scenarios are developed in the form of narratives of (3) possible futures. These narratives will capture uncertainties regarding generic Global trends and, more specifically, the trends in European agri-food and veterinary sectors. Thereby, we include trends in sustainable production, the bio-economy, digitalisation and business models. The aim is to cover a wide range of uncertainties indicated by trends identified in the previous section. The narratives will connect different trends into an integrated exploration of possible futures.

Following Mitter *et al.* (2020) we take the ''Shared Socio-economic Pathways'' (SSPs, O'Neil et al, 2017, 2014) as a starting point. The SSPs capture climate mitigation uncertainties in 5 possible pathways/scenarios. Several studies mentioned above base their approach on these SSPs and have translated these into scenarios for European agri- and food systems, thereby including trends that are typical for European food and agriculture.

Although the SSPs on which several scenario studies mentioned built have taken climate change as starting point, the trends or drivers taken into account in these studies extend environmental issues by including generic Global economic, political, social and technological developments: ''… the SSPs can also be useful in other contexts relating more broadly to sustainable development. This is due to the fact that socio-economic challenges are closely linked to different degrees of socio-economic development and sustainability...'' (O'Neil *et al.*, 2017).

4.1.   Country level scenarios and skill needs

In this study five country-specific scenario analyses were executed. Further, for every scenario at country level skill needs were identified by the country teams of the FIELDS/I-RESTART project. These are included in

the country reports. In this section, we focus on the differences in skill needs between countries for every scenario. Based on the interpretation of the trend studies, the country teams selected max 5 skills per dimension per scenario.

4.1.1. Skill needs for scenario Sustainable Pathways

Table 10 presents typical skills of 10 countries for the Sustainable Pathways scenario. Although we see a distribution of diverse skills, some of the skills are among the selection of several countries. The sustainability and bio-economy dimensions skills that were selected multiple times are Soil nutrient and health management, Crop diversification and crop rotation, Biodiversity, Renewable energy, New (biobased) products and Sustainable packing. However, there are also clear differences between the country selections, such as the specific attention to water management-related skills in Spain.

In the digitalisation dimension skills like Everyday usage of digital technologies were selected multiple times, next to advanced digital skills like Precision farming, Precision animal health management, Field operations and Robot and drone technology. In the business model dimension communication and learning skills prevail, such as Networking, Learning skills, Direct marketing and New value chains.

Table 1 Skill needs per country for the scenario Sustainable Pathways

Netherlands	Austria	France	Spain	Italy
-Minerals and emissions accounting - Improved agrifood system productivity -Renewable energy -Multifunctional ecosystem services -Sustainable packaging	-Biodiversity -By/co-products valorisation -Generation renewable energy -Soil nutrient and health management	-By/co-products valorisation (circularity) - Sustainable packaging -Organic farming - Agricultural biodiversity -Animal care and welfare	-Water management -Organic farming -Agricultural biodiversity -Animal care and welfare -Biofertilizers, compost, bio digestates	-Mitigation/ adaptation to climate change -Improved agrifood system productivity -Identification of renewable energy systems -Water management. -Soil Nutrient and Health Management
-Biobased production -Crop diversification and crop rotation -Biodiversity -Ethics for food	-Organic farming -New crops for bioeconomy -Plant/animal breeding resilience -Food security	-Crop diversification and crop rotation -Biodiversity -By/co-products valorisation -Generation renewable energy -Sustainable packaging	-Biobased production -Reclaimed water management -By/co-products valorisation -Generation of renewable energy -Sustainable packaging	-Conventional and Organic farming -Controlled Environment Agriculture -Agricultural biodiversity -Farming operations
-Stakeholder communication - Digital entrepreneurship -Precision animal health	-Everyday usage digital technology -Data handling	-Digital entrepreneurship -Precision animal health system -Field operations system	-Stakeholder communication system -Food Industry 4.0	-Digital entrepreneurship -Warehouse management systems

-Field operations management -Robot and drone technology	-Digital pest control systems -Farm Management IS -Precision animal health system	-Robot and drone technology -Food industry 4.0	-Food traceability -Precision animal health and productivity -Robot and drone technology	-Digital food traceability system -Precision animal health and productivity -Field operations management
-Multi-functional farming -Change man. -Learning continuously -Innovative thinking -New value chains	-Being resilient, and proactive -Networking -Learning at work -New value chains -Collab. across sectors	-Networking -Learning continuously -Direct marketing -New value chains	-Multi-functional farming -Networking -Cooperatives -Direct marketing -New value chains	-Cooperatives -New value chains - Collaboration across all sectors in the food chain -Social expectations. Consumer science & behaviour -Product development

4.1.2. Skill needs for scenario Established Pathways

Table 11 presents typical skills for the Established Pathways scenario. The sustainability and bio-economy dimension skills that were selected typically relate to Good agricultural practices (and Production management), Integrated pest management, Water management and how to turn to Organic production. Another item selected several times is skills related to Biodiversity, probably related to the ongoing decrease of biodiversity in several countries. Further, traceability and labelling/certification are considered key skills for the Established Pathways scenario.

In the digitalisation dimension skills are, in comparison with the Sustainable Pathway scenario, more related to farm management practices, such as Farm management information system, Everyday usage of digital technology, Traceability. Although, also in this scenario there is attention, although less prominent, to skills related to Robots and Drones and Precision farming. Similarly, also the business model skills relate more to business management practices, such as financial business planning and (working with) Cooperatives. However, also in this scenario we see Multifunctional farming as an important subject that needs skill development, as this is an ongoing trend in several countries.

Table 2 Skill needs per country for the scenario Established Pathways

Netherlands	Austria	France	Spain	Italy
-Minerals and emissions accounting -Integrated pest management. -Generation renewable. energy -Soil nutrient and health -Water management	-Mitigation and adaptation to climate change -Efficient use of resources -Integrated pest man. -By-products and co-products valorisation -Water man.	-By-products valorisation -Sustainable packaging -Organic farming -Agricultural biodiversity -Good agricultural practices	-Water management -Good agricultural practices -Agricultural biodiversity -Animal care and welfare - Biofertilizers, compost, bio digestates	-Improved agri-food system productivity -Management of natural resources -Environmental policies, regulation, etc. -Good Agricult. Practices -By/co-products valorisation
-Convent. vs organic -Controlled agriculture systems -Traceability -Food labelling	-Traceability -Organic farming -Food labelling	-Conventional vs organic production -Controlled agriculture systems -Traceability -Food labelling -Sustainable packaging	-Reclaimed water man. -By/co-products -Generation renewable energy -Sustainable packaging	-Planning and coordinating production -Calculating, handling and managing risk -Logistics and storage -Quality management, -Management of inventories
-Everyday usage of digital technology. -Digital food traceability system -Farm MIS	-Everyday usage digital technology -Data handling and analysis -E-commerce and e-marketing -Digital services	-Everyday usage digital technology -Digital food traceability system -Farm management IS -Precision animal health system	-Food Industry 4.0 -Everyday usage of digital techn. -Digital food traceability system	-Everyday usage digital technology -E-commerce and e-marketing -Warehouse management systems -Farm MIS

-Precision animal health system -Field operations management system	-Precision animal health system	-Robot and drone technology	-Precision animal health and productivity -Robot/drone technology	-Precision animal health and productivity
-Multi-functional farming -Organisation, strategic thinking -Financial business planning -Coops -knowledge to assess value chain	-Communication -Analytical and creative thinking -Financial business planning -Funding opportunities -Project management	-Organisation and strategic thinking -Financial business planning -Coops -Food labelling/certification	-Multi-functional farming -Organisation and strategic thinking -Innovative thinking -Cooperatives -Food labelling/ certifications	-Monitoring market activity and conditions -Customer's service -Cooperatives -Project management -Specific sector legislation

Table 12 presents typical skills of 5 countries for the High-Tech Pathways scenario. For the sustainability and bio-economy dimensions skills that were selected typically relate to new and innovative products and processes; for products and by-products valorisation, Biobased products, New industrial crops. Further, it is interesting to see that several country teams selected Continuous improvement as a skill needed for the High-Tech Pathways scenario.

In the digitalisation dimension typical skills like E-commerce & Marketing, Supply chain information systems, and Digital information and services are selected, next to high-tech Cloud technology and Robots and Drones. Business model skills for this scenario relate to Innovative thinking, Supply chain management, Monitoring of markets, New Value chains and IPR protection.

All three scenarios present a diverse set of skill needs for the seven countries selected. However, every scenario has its unique accents, just as every country has its typical skill selection.

Table 3 Skill needs per country for the scenario High-Tech Pathways

Netherlands	Austria	France	Spain	Italy
-Efficient use of resources -Improved agri-food production -By-products valorisation. -Renewable energy -Sustainable packaging	-Improved agri-food system productivity -Sustainable metrics -Energy consumption -Sustainable packaging	-By-products valorisation (circularity) -Renewable energy - Sustainable packaging -Organic farming -Agricultural biodiversity	-Personalized functional foods -Circular production -Water management -Digital irrigation systems - Biofertilizers compost, bio digestates	-Efficient use of resources and logistics -Improved agri-food system productivity -Management of natural resources -By/co-products valorisation -Identification of renewable energy
-Biobased production -New industrial crops -Traceability. -Emerging technologies	-Controlled Environment Agriculture -Livestock efficiency/ biosecurity -Handling and managing risks -Continuous improvement -Management of inventories	-By-products and co-products - Sustainable packaging - Traceability -Emerging technologies	-Biobased production -reclaimed water man. -digital tools for energy use -By-products and co-products -Sustainable packaging	-Genetically Modified Crops -New crops and bioproducts for the bioeconomy -Plant and animal breeding -Food safety management -New technologies in paper, pulp etc. manufacturing
-Supply chain information systems -Digital services -E-commerce and e-market. -Climate control systems -Robot and drone technology	-Cloud technology -Digital services -Precision animal health system -Field operations management systems -Robot and drone technology	-Data protection -E-commerce and e-marketing -Climate control systems -Robot and drone technology	-Supply chain IS -Food Industry 4.0 -Digital business management -Precision animal health and productivity -Robot and drone technology	-Data handling and analysis -Cloud technology -Decision support systems (DSS) -Farm Management Information Systems (FMIS) -Precision animal health and productivity
-Wood Supply Chain Man. -Innovative thinking -New value chains -Innovation management -Protection intellectual property rights	-Equality skills -Managing personnel -New value chains -Protection intellectual property rights -Specific sector legislation	-Innovative thinking - Monitoring market activity and conditions -Business planning/model and strategic management -Protection intellectual property rights	-Food supply chain management -Logistics and storage -Monitoring market activity -Business planning, strategic man. -New value chains	-Monitoring market activity and conditions -Sales and marketing -Business planning/model and strategic management -New value chains -Product development

5. Skill lists from I-RESTART partner's input.

Initial lists were prepared by ISEKI, based on online search of scientific literature and grey literature (reports from private institutions and governmental agencies).

The lists were shared partners, for them to provide input by correcting or adding new skills.

5.1. One Health

1. Human health and wellbeing
2. Public health
3. One health socioeconomic determinants
4. One health related policy and legislation
5. Environmental health/ecology
6. COVID-19 fostered skills (e.g. zoonosis control)
7. Principles of epidemiology and surveillance
8. Disease management
9. Emerging infectious diseases
10. Risk management, (incl. crisis and risk communication)
11. Food and water safety (incl. new technologies for food safety)
12. Modern strategies in food safety for risk mitigation
13. Food contaminants and incoming legislation
14. Food fraud
15. Food defence
16. Feed and food security
17. Nutraceutical and health claims
18. Healthy, sustainable and personalised diets (incl. special population groups)
19. Gut microbiome

5.2. One Health skills specific for animal production

20. Animal health and wellbeing
21. Antimicrobial resistance

5.3. One Health skills specific for Veterinary activities

22. Principles of epidemiology and surveillance
23. Emerging animal diseases: prevention, treatment and impact on humans
24. Responsible use of medicines
25. Ante-mortem and post-mortem meat inspection
26. Best practices for small animals and pets' business
27. Diagnostic monitoring of animal health

5.4. One Health skills specific for Food Industry

28. Food texture
29. New protein sources
30. Novel foods
31. Packaging and food contact materials
32. Labelling and new challenges

5.5. Sector specific emerging trends

1. Agriculture policy
2. Emerging technologies

3.   High level of expertise
4.   Food Systems
5.   Process optimization
6.   Logistics (considering both local and global value chain and challenges)
7.   Quality control
8.   Raw material supply management
9.   Working with retail
10.   Product environmental footprint of agri-food products
11.   Digital export
12.   Internationalisation
13.   Legislation and policies

5.5.1.   Sector specific emerging trends skills specific for animal production

14.   Future farming
15.   Animal wellness

5.5.2.   Sector specific emerging trends skills specific for Veterinary activities

16.   Role of veterinarians in agri-food industries: health control and food quality and safety control
17.   Food product development
18.   Knowledge and integration of emerging technologies in veterinary activities
19.   Basic Zootechnic notions and Symbiotic animal husbandry
20.   Animal-assisted therapies (social, educational)

5.5.3.   Sector specific emerging trends skills specific for food industry

21.   Industry 4.0 concepts and technologies
22.   Food product development
23.   Packaging
24.   Labelling
25.   Food information to consumers

6. Urgent skills need identified per country

In this section the urgent skills needs fostered by the COVID-19 crisis, the emerging technologies and the green and digital transition in the animal production, veterinary activities and food-industry sectors, and that were identified during the conduction of the I-RESTART Focus Groups, have been grouped per country. For each sector the skill list is followed by the reason and participants' comments, explaining why the skill is important for their sector.

6.1. Animal production

Table 4 Urgent skills needs fostered by the COVID-19 crisis, emerging technologies, green and digital transition in the animal production sector divided by country

Country	Digitalisation	Sustainability And Bioeconomy	Business-Entrepreneurship and Soft Skills	One Health	Sector Specific Skills
Austria Skills	- Data management (complexity research, big data, data analysis) - Risk management for digital data/products - Data utilisation (ethics, law, data protection) - Online presence - animal husbandry technologies	- Animal husbandry / welfare - Quality (as an umbrella term e.g., during production) - Knowledge about nutrient cycles - Knowledge in the field of biodiversity/ basic - knowledge in biology and botany	- Knowledge of sales and customer management in the B2C area; negotiation skills in the B2B area - Explanatory production - Market- and legal knowledge, business management skills - Risk management - Professional value creation - Machine communities (reduction of operating costs) - Diversification of acquisitions	- Advocacy - Anti-microbial resistance - Sustainability - Animal health and wellness	- Raw material supply management - Market connection/ knowledge - Risk management - Agriculture of the future - Target group-oriented production - Precision agriculture
Austria Reason	- Dozens of robots are already used on farms for support, generating a lot of data. Employees	- Making transparent how animals are kept; here participants emphasised animal welfare. One	- There are two groups of possible customers: further processing companies and consumers.	- One health should not be an additional responsibility of common food production workers.	- Over- and underabundance of produce are omnipresent at the food market. The

	therefore need to have a general understanding of data management. - The networking of machines is not only helpful but can also involve risks, and it is important to be able to assess them. - A topic that will be interesting for the future, i.e., what happens with my data but not necessarily a question for the end user himself. - Online presence, be it via social media or blogs, helps farmers with direct marketing and creates transparency. - Many technologies are already available, in-depth training mostly provided directly by the companies themselves.	participant noted that not so much the animal husbandry labelling itself during production is important, but the standards according to which the farm operates. - Participants also acknowledged that this may be less a topic for farmers themselves but more for the consumers. - The discussion about animal welfare led to the question of the definition of quality. - Nutrient cycles, together with circular economy or circular agriculture are becoming increasingly important due to the farm-to-fork strategy of the Green New Deal. The participants particularly pointed out the possibility of recycling waste from the food sector, for example as animal feed. However, participants also point out that there are legal hurdles to be considered as well as it being something for authorities rather than the farmers themselves but still considered it as an	Farmers should therefore be well versed in operational and customer management. The participants see a great potential in offering such trainings. They should be easily accessible, understandable, and preferably containing innovative teaching methods. - Although business management skills are usually already taught during education, they are essential skills for farmers to have as most farmers are self-employed. - The economic situation for small farms is becoming increasingly difficult. However, in the eyes of the participants, strengthening small farms is an agricultural policy requirement, e.g. by means of support from the chambers of agriculture, and not something that can necessarily be solved with the help of learning materials. - Something that could help is creating cooperations	- There are already many courses/info events covering this subject. However, it still remains as a prominent and urgent topic, as was discussed beforehand. - - All three dimensions of sustainability should be considered, not only the ecological sustainability (Ecological, economic and social). Has been previously strongly discussed and supported as a one health measure.	farmers are unable to gauge current market trends and tend to over- or under-produce goods. This leads to unnecessary resource waste and labour. - Knowledge about market trends and possible reactions (risk management) to fluctuations. - Was deemed as too broad of a term and therefore split into its most important aspects listed below (Target group-oriented production, Precision agriculture) - Better targeting of specific groups and gearing of production towards them through innovative methods. Resource management and Optimization

		important training opportunity for the future. - One participant found these skills missing in the template provided before the focus group.	among smaller farm(er)s to reduce operating costs and increase economic results. Reduction of the entrepreneurial risk through a broader positioning of one's farm, i.e. having multiple income sources.		
Denmark Skills	- Accurate data collection - Food supply chain - Traceability (mainly traceability processes) - Digitalisation (mostly for innovations)	- Bioeconomy strategies - Emissions from activities - Animal welfare - Marketing the Sustainability	- Business modelling - Basic of economic and financial issues - Conflict management - Policies and regulations on health and safety in the workplace - Negotiation skills	- Human health and wellbeing - Public health - One health related policy and legislation	- Emerging technologies - Food systems
Denmark Reason	- This skill helps farmers to have better decision-making after having collected the data they need. - Farmers should be more informed about next key stages after production (handling and storage, processing and packaging, distribution, retailing, consumption) - All animal farming customers' segments demand the traceability processes to be followed accurately. - Digitalisation in business	- Farmers would benefit from this skill training as they need to add to their daily agenda the promotion of business sustainability development. - It is important to acknowledge the environmental harm the production of animal products causes. Not all farmers are aware. - Animal welfare is an essential element of modern animal production. Consumers' demands are increasing	- Business modelling skills are important because they help farmers develop a roadmap for their business future and enables them to attract more customers. - Learning about relevant economic skills and how to apply them to the business would be very beneficial for Danish farmers because they'll understand the economic concepts. - Danish farmers should benefit from training on conflict management skills. It might offer them conflict	- Additional knowledge has to be shared regarding the importance of the connection between animal welfare, industrial farm animal production and human health consequences. - Public health knowledge is mandatory to animal farmers. Public health can be achieved if breeding makes full use of knowledge. - Farmers need to implement the one-health approach on a daily basis. Both understanding and	- Animal farming demands the implementation of modern technologies. Danish farmers should have access to this information. - Food systems' knowledge is needed for the awareness of the urgency of food systems transformation. E.g., more sustainable food systems is an urgent need in Denmark. - Danish farmers are called to contribute to a greener and more sustainable transformation of food

	has a great impact on innovations. When technologies become more and more advanced, they force farmers to innovate.	and they ask for a lot of information on this topic. Farmers with marketing skills (marketing their sustainable products or company) can attract more customers and improve their company reputation.	resolution strategies. Although Danish try to avoid conflicts to a certain extent, more conflicts happen in the workplace but also with customers. - Personality, communication style, work ethic between farm workers can lead to conflict. - A well-trained worker on safety is more effective at work. - A well-trained negotiation mindset is beneficial when the aim is an agreement. Negotiation skills can be tough to learn, so continuous training is needed.	interpreting legislation need to be upgraded constantly.	systems. e.g. The Danish government has an objective of doubling the Danish organic area by 2030.
Germany skills	- Basic knowledge of IT/ industry-specific software - Problem solving skills. - Linking sensor data with barn technology - Good field service of the companies/competence	- Animal handling animal welfare - Monitoring of areas - drones/GIS - Land management systems	- Marketing / Direct marketing / Communication - Negotiation skills - Mental stress - Occupational health and safety	- Hygiene regulations and disease prevention - Stable hygiene regulation	- Skill - Addressing the social debate on meat consumption and animal welfare - Insect husbandry - Interdisciplinary agriculture / broad expertise/interdisciplinary knowledge
Germany Reason	- Digital, especially data competence gets ever important. However, many farmers are not able to	- Animal handling touches many points from animal welfare to digitalization and is therefore pivotal to	- Marketing and direct marketing are very important especially for smaller animal husbandry	- This should be pointed out clearer since it is the cause for many problems that could follow for the three	- Reason(s) Farmers are confronted with societal trends such as animal welfare and

handle data properly. They use several different systems, but data is often not harmonised and when problems occur, farmers often cannot solve them on their own. - Technologies often mean challenges for farmers they are not trained for, and it is unrealistic that they can be trained in the future in such an extent that they are able to solve every technical problem. - Lot of sensor data are being generated. However, the efficient integration of those data into barn technologies is often lacking. - Referring to the points already mentioned: technical problems can sometimes be too difficult and specific to be solved by a farmer. Therefore, support by the software company on the field is pivotal.	have competences in this field. - Animal welfare was considered as very important, also because of the society which is ever closer watching the activities in this area. - Participants found it important, also under the focus of sustainability, to be able to monitor herds and livestock remotely without the need of driving out there that often. - Has been indicated as very important for the future and to efficiently run an animal production business.	forms such as sheep keeping where a great deal also consists of landscape management and meat production/selling comes second. This goes hand in hand with communication of ecosystem services. This communication needs to be fostered. - Direct marketing is also pivotal for those farms that apply animal welfare systems. Social media are getting more important also in this area. - Many producers do not know how to negotiate wisely with bigger intermediates, supermarkets, or slaughterhouses. Yet, negotiation skills is a prerequisite for successful direct marketing. - Since most producers are self-employed financial stress is a huge topic. For example, piglet producers are not integrated in the animal welfare labelling system which leads to a weak negotiation position. - Apparently, more animal welfare leads to more	areas of one health. According to skills must be trained. Vectors for diseases are spreading more easily due to rising temperatures and herds are growing bigger and bigger. - It is pivotal that skills for stable hygiene regulations are trained rigorously to keep the herds healthy. African swine fever and avian influenza are an important aspect here as well.	sustainability. Skills are needed to address these issues sufficiently. - New forms of animal husbandry as answers for societal changes. - New demands for all fields of farming are emerging. Therefore, it is important that farmers gain a holistic view.

			manual labour for farmers and consequently can lead to more health risks.		
Greece skils	- Chip for animal tracking - Knowledge upgrade, re-skilling & up-skilling - Smart personalized feeding systems - Reproduction control systems - Updating - keeping electronic logs of the unit	- Waste management - New animal feeds - Energy & its management - Environmental footprint - Environment protection	- Observation - Collaborative work - Extensive and intensive livestock farming - Co-operative activities with other livestock farmers - Compliance, Patience, Responsibility, Seriousness Protocols	- New animal welfare rules - Antibiotics - Traceability - Legislation	- Agriculture policy - Emerging technologies - Animal wellness - Product environmental footprint of agri-food products
Greece Reason	- A necessary tool for farmers with livestock growing in an extensive environment - IT essential tool for the operation of a modern livestock unit - Upgrading the operation of the livestock unit and the proper feeding of each animal - More precise monitoring of the reproduction cycle of each animal on livestock farms - Collecting and understanding data	- Proper waste handling - Understanding and comparison with common animal feeds; awareness of their application methodology; new legislative frameworks. - Proper feeding practices - Future Livestock Obligations - A need to understand basic environmental protection issues such as maintaining a clean environment	- instant problem detection - Livestock unit development - Additional knowledge specialization - Knowledge expansion - Proper situation handling - Protocol compliance	- Understanding the concept of animal welfare and following the new legislative framework proper use of antibiotics - Data retention and assurance of safe product supply - in line with the new legislation	- Keep up with new obligations - Improvement of the operation of a livestock unit - animal welfare & health - new legislation
Italy Skills	- Market analysis tools - Logistics -food chains - Data management tools	- Certification System models - Consumer Information	- English Language - Leadership Skills - Team work	- Human health and well-being - Skills promoted by COVID-19	- Emerging technologies - Food systems - Process optimization - The farming of the future

	- Digital predictive statistical models - A.I.	- Water soil and natural resources management - By-products and waste management - Circular Economy	- All-encompassing approach - Teaching how to learn - Certification and life-long learning.	- Conscious choices - Animal health and welfare - Opportunities offered by AI - Modern food safety strategies for risk reduction - Emerging Infectious Diseases - Antimicrobial Resistance	- Animal Welfare
Italy Reason	- The ability to do market analysis capable of being on the market in this historical moment. - The importance of logistics as a key aspect as it relates to labelling and consumer information. - Data management tools prove to be essential for proper animal production activities. - It is relevant not to lose a systemic view within digital statistical model. - Bringing AI to benefit the animal production sector.	- the need for company sustainability certifications to be part of a system and to always be recognized as valid. - Labelling is essential for informed consumer choices. - Solutions on land management should be conceived practically, not academically. - Improvement of the waste management. - Raise awareness of the circular economy and related impact.	- Basic knowledge required. - To guide and stimulate the team. - The ability to work in a team in order to stimulate empathy and collaboration. - The ability to see things comprehensively, without limiting oneself to one's area of expertise. - Develop a learning method capable of being updated even after the course of study has been completed. This is in order to train people who will be able to continue learning in the future. - Need to distinguish postgraduate certification from life-long learning.	- Animal production directly affects human well-being and health, these are issues that it is important to spread with awareness. - The skills learned during covid are a treasure to cultivate so that we are no longer caught off guard by future pandemic crises. - The ability to fully understand the choices you make and all their consequences for animals, humans and the planet. - AIs create exciting new opportunities in the world of human and veterinary medicine. The use of technologies will reduce many future risks. - Knowledge of animal diseases that affect humans but also the health of the planet.	- The ability to use emerging technologies is necessary to have workers integrated with the processes of the time. - Knowledge of food systems is an important skill for animal care and also for the one health approach. - Process optimization must be known in order to continue to treat and keep animals and their products under control. - The change of breeding systems between drought and new market areas. - Animal welfare as the main guide for working closely with production and industry.

Portugal Skills	- Food supply chain - Technical skills for food processing - Basics of digitization - Operation of typical machines, robots and applications in smart farming - System integration and data transfer	- Water - Air and atmosphere - Policy and Regulations - Good agricultural practices - Circular economy	- Teamwork, negotiation and conflict management - Basic ICT skills - From traditional to digital food marketing - Safety and health at work - Organisation and planning - Innovation management - Lifelong learning and continuous learning	- Antimicrobial resistance - Public health - Animal health and welfare - Food and water safety - Security of food and feed supply - environmental health/ecology - Principles of Epidemiology and Control	- High level of expertise - Animal welfare - Farming the future - Optimization of processes - Waste food, food waste - Packaging - Logistics - Informing customers, the media and the general public
Portugal Reason	- In connection with food industry	- It is more important - Of everyday importance - Basis for operation - It connects with each other - We have to find the common thread	- A lot related to character, important for good business results. - Bound by law - Use in every workplace - A new way of selling - It keeps you in touch with the profession	- Reducing food waste, using waste food for animal feed (recycling)	- Associated with use in animal nutrition - Optimization of processes - People's trust, the importance of the media
Slovenia skills	- Food supply chain - Technical skills for food processing (for food industry - Basics of digitization - Operation of typical machines, robots and applications in smart farming - System integration and data transfer	- Water - Air and atmosphere - Policy and Regulations - Good agricultural practices - Circular economy	- Teamwork, negotiation and conflict management - Basic ICT skills - From traditional to digital food marketing - Safety and health at work - Organization and planning - Innovation management - Lifelong learning and continuous learning	- Antimicrobial resistance - Public health - Animal health and welfare - Food and water safety - Security of food and feed supply - environmental health/ecology - Principles of Epidemiology and Control	- High level of expertise - Animal welfare - Farming the future - Optimization of processes - Waste food, food waste - Packaging - Logistics - Informing customers, the media and the general public
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			We have to find the common thread	A new way of selling It keeps you in touch with the profession		
Spain Skills	- Communication with the authorities. Improving the exchange of information through digital channels - Introduction to methodologies for analysing information and making the right decisions - How to evaluate all the data received in order to make effective use of it - Knowing what benefits, including innovation, are obtained by including digitalisation in your business - Ability to process current information and make decisions in time - How to improve the economic management of the farm with the introduction of the several digital tools - Raising awareness of the benefits of sharing information through new digital tools/applications	- Responsible use of veterinary medical products - Good practices in slurry and manure management - SOIL. Other uses of the livestock activity and its valorisation: livestock care of the forest masses - Good practices in recruitment	- Awareness-raising on the positive impacts of agri-livestock activity on society in general and the rural environment - Raising awareness of the importance of the human factor - Mainstreaming diversity in the sector - Improving the understanding of the whole agri-food chain: from the producer to the final consumer. - Teaching to think differently to be innovative - Present new business models that meet the needs of professionals - Identification of tasks and roles - Development of communication skills	- Infectious diseases in livestock and their treatment throughout the food chain. - Biosecurity, prevention, health crisis management - Nutritional facts, healthy diets, intestinal microbiome - Food waste - Food safety along the whole food chain - Animal welfare - Environmental impact of livestock farming	- New social movements/thinking (deforestation, ODS) and their influence on changes in production models - Provision/creation of new products/ingredients/raw materials - Packaging. New uses/products with new raw materials
Spain Reason	The livestock sector must transmit information to the authorities in order to comply with its legal	It is desirable to separate the concept of animal welfare from the responsible use of	It is important to frame the activity and what it represents from an economic, environmental	- Farmers play a key role in maintaining optimal animal health status. An emphasis on good practice	- Previous points have identified the need to attract society to the agri-food sector, and in

obligations. The trend is increasing and soon this flow of information will be done digitally.
- In an increasingly technological environment, it is essential to receive training to know how to use the information provided by the digital environment.
- It is necessary to know the basis of the technologies in order to manage this information correctly.
- The livestock cooperative sector is mindful of the importance of introducing training in digitisation as a source of opportunities to improve the business prospects of the activity concerned in the value chain.
- The use of the new "digital" modes at farm level lacks the necessary agility for the handling of a large amount of information to have an optimal result in decision making.
- Either because there are more and more legal obligations in the

antimicrobials. For the health of the animal itself and for public health.
- It is necessary to raise awareness in livestock waste because the ability of companies and professionals in the sector to correctly and efficiently separate the different types of substances or materials discarded results in better use through recycling and reuse.
- The inclusion of circular economy is important in the approach to good practices. It is necessary to provide training that takes this aspect. Awareness must be raised about the valorisation of livestock waste.
- The extensive livestock farming and grazing is an essential activity that has carried out considerable work in protecting and maintaining the ecosystem that surrounds rural areas. Its functions include, among others, the conservation of biodiversity, the prevention of fires and

and social perspective. Highlight the strategic role of the livestock sector in relation to the SDGs.
- It is considered essential to add a module that incorporates these two cross-cutting aspects in a specific way problem of a lack of generational renewal and of representation of women
- In view of contributing to the economic sustainability of the sector, it is necessary to improve the knowledge of the whole agri-food chain. The essential role of producers must also be highlighted.
- Two important building blocks of innovation are: creativity and thinking differently. This means looking for ways to think differently to produce better practices and generate ideas and solutions.
- In order to ensure a commitment to the agri-food sector and to livestock production, it is necessary to develop new business models that also

awareness and training on the responsible use of veterinary medicines is a significant contribution to good health management, to disease minimisation
- It brings together those aspects that are considered most important in terms of knowledge/education to pay attention to.
- A high percentage of the food available in the world is rejected, and this has a strong economic, social and environmental impact. In addition, it generates a waste of non-infinite resources used in food production and in its transport, storage and packaging.
- Another of the topics has to do with awareness-raising, good practices and prevention in the area of food safety. This covers food production, storage, distribution and preparation, and therefore involves a wide range of actors, including consumers.

particular to the livestock sector, in order to enhance the value of the activity, making known the things that are done well and that are positive and bring benefits to society as a whole. At this point, the opposite process is addressed. Letting the sector understand what is happening in the world, what new trends and social movements there are, and why these new trends and social movements are also influencing the sector. And why these new trends also have an impact on the sector to activate changes in production models.
- The associative livestock sector is integrated in the agri-food chain, providing a wide variety of products. Not only foodstuffs, fresh or processed, to the end consumer (milk, meat, cheese, yoghurts...) but also inputs to the sector itself (animal feed). There is also a wide potential to

	management of companies or farms in the livestock sector, or because "digitalisation" as a whole is increasingly present. A global approach, taking into account the whole activity, would be optimal. - In the development of livestock farming and their co-operatives, it is often more beneficial to share information with others.	minimisation of deforestation, and the reduction of fossil fuel emissions. On the other hand, there is a chapter on Policy and regulations, which could include awareness-raising aspects, in everything that has to do with recruitment in the company, which can be linked to social sustainability for the worker	respond to the expectations and needs of young people in rural areas. - Establishing roles in a working team is not a simple task. Their assignment depends on the technical-professional-human skills. It therefore requires a detailed knowledge of the participants, which must be based on both professional and human terms. - A skill that is particularly important is the one linked to communication. The internal one is linked to people management aspects and the external one to marketing-oriented issues.	The purpose of this training is to help the farmer to comply with the regulations and to guide him in adapting their farms and animal management in order to provide the animals with the required animal welfare conditions. - The impact of livestock farming on the environment is also highly regulated. Training in this area must be focused on making it easier for livestock farmers to comply with environmental requirements.	be exploited and developed in the field of ingredients and/or raw materials (bioplastics, cosmetics, etc.) for other industrial sectors.
The Netherlands Skills	- Effective communication with authorities and government	- General skills - Responsible use of veterinary medical products - N-regulations and manure management - Animal welfare organisations make	- Communication in the media and in politics. - Improving the understanding of the whole agri-food chain, from the producer to the final consumer	- Infectious diseases in livestock and their treatment throughout the food chain. Biosecurity, prevention, health crisis management.	- Risk management & communication - Food & surface water management - Food safety and marketing skills

| | | political statements against farmers | - Survival strategy for smaller farmers to develop new products
- Business planning/model and strategic management.
- Developing communication skills and writing skills | - Awareness raising of Food waste.

- Food safety along the whole food chain.

- Animal welfare and health.

- Environmental impact of livestock farming. | - Provision/creation of new products/ingredients /raw materials |
| The Netherlands
Reason | - Is essential for improving the future of Dutch farming. This includes addressing issues such as the exclusion of smaller farmers, expanding nature conservation areas, and managing N-trends. | - N/A | - N/A | - N/A | - N/A |

6.2.   Veterinarian activities

Table 5 Urgent skills needs fostered by the COVID-19 crisis, emerging technologies, green and digital transition in the veterinarian activities sector divided by country

Country/ Skills	Digitalisation	Sustainability And Bioeconomy	Business-Entrepreneurship and Soft Skills	One Health	Sector Specific Skills
Austria Skills	- Data analysis - Specific farming IT skills - Precision livestock farming - Specific education - Data connection and traceability	- Minimization of water and energy demand - Soil function and condition - Sustainable circular economy - Legal framework	- Self-employed working - Understanding of farming operations - Consulting skills - Interprofessional teamwork	- Antibiotic resistance - Influence of drugs on the environment - Avoidance of unnecessary medication - Emerging diseases	- Ecological footprint - Symbiotic animal husbandry - Organic production - Interprofessional cooperative collaboration

		Systemic climate change	Hazards when working with large animals	HACCP and quality management	Raw material supply
				Security of vegan food	
Austria Reason	- There is a huge need for personnel expenses to process data collected by several sensors. It gets increasingly important to have skills in data interpretation, making decision trees and avoidance schemes. - Basic IT skills specific for veterinarians working on farms are not covered in the university education, but introduced only in practice at farms (learning by doing). - Austria as a rather small country may not have the affordability for huge livestock farming, however this is an important competence in the future. - Veterinarian education is very broad and offered only at one university in Austria. It would be useful to develop more education possibilities, in a smaller range and more specific. - Farmers and veterinarians should be trained together	- This is an increasingly important issue for all (veterinarian) activities in the food industry and animal production, concerning every single business and confronting veterinarians. - This topic is very prominent in agricultural businesses, but veterinarians lack this education, which is a problem when they give advice to farms. - There is no training available that includes all of the - various topics of circular economy, what makes it difficult to establish connections. This should be part of future veterinarian skills. - The legal framework changes frequently, is difficult to understand and veterinarians struggle to take their time to read in. - Climate change will affect veterinarian professions	- Working as a self-employed veterinarian needs skills that are not included in university education. Topics like business management, economic understanding, tax issues, duty of care towards employees, cost accounting, etc. are picked up during practical work. - To lead a successful veterinarian business working in animal production, an understanding of farming operations is indispensable. Special focus should be laid on farming sizes, feasibility is different for direct marketers vs. small/medium enterprises. - Veterinarians need to strengthen their consulting skills to make farmers willing to pay for their advice and routine activities. This includes a broad knowledge in the field and the competences	- Understanding and preventing antibiotic resistances is one of the key topics of One Health, however, the Austrian university focuses already on it. - Drugs given to animals are excreted into the environment and have several, partly unknown influences, e.g. antiparasitic kill insects the environment, development and transmission of resistances are facilitated by soil bacteria. - Veterinarians need to be trained to make precise diagnosis and accordingly administer only necessary medication. Precise analysis of the health status of an animal often allows the avoidance of medication (e.g. deworming of a dog is only necessary when it has worms). - Emerging diseases,	- Data about the ecological footprint of food products are often not adapted to Austria/Europe (e.g. methane emission of cows). The sector needs more knowledge about what is applicable for the respective country. - There is a clear trend towards animal welfare, also demanded by the consumers. Symbiotic animal husbandry would be a good way to realise this, but there are many limits in terms of legal provisions (concerning bacterial transfer, etc.). Veterinarians need the knowhow to give advice in this field. - Veterinarians need more training regarding organic production. They often don't know what farms are allowed to do and what not. E.g., organic swine production is still a niche in Austria (2 %). - Cooperative collaboration

to better understand digital tools and facilitate data connection and traceability.	and accordingly skill needs. E.g., veterinarians' main activity in the health sector and food industry is meat inspection, but a decrease of meat production is probable in the future.	to sell it. - There is a lack of collaboration between veterinarians and farmers. Interprofessional teamwork should be used to find solutions for occurring problems. Further, advanced education/upskilling should be offered for both sectors together to enhance the connection. - Veterinarians are facing several hazards when working in farming operations. - Beyond mechanical and electrical hazards, hazards regarding working with large animals should be more considered in education.	facilitated by climate change, are an increasingly important topic, including zoonoses. - Broad knowledge is indispensable to set up HACCP and quality management systems, which are necessary in every company, e.g. to enhance animal health, avoid contaminations, etc. Logic and joined-up thinking needs to be imparted. - Changing eating habits (vegetarian, vegan diets) lead to an enhanced production of meat, egg and milk substitutes, which inhabit new microorganisms. These new products are often developed by start-ups, which don't necessarily have the skills to do a proper microbiological analysis.	of different professions is necessary to overcome future obstacles. Veterinarians, human medics, farmers, microbiologists, etc. need to learn how to share their competences. - It is important to be up to date about the current world economic situation, to know about which raw materials are available, local alternatives and possibilities in other countries (considering that surveillance varies even within the EU).
Denmark Skills	- Systematic data collection - Data collection, data recording	- Sustainability/ Bio-economy concept - Sustainability agenda	- Basics of economic and financial issues	- Human health and wellbeing	- Process optimization - Interpret legislation

	- New technologies that support decision making - Food processing technical skills - Handle of AI platforms	- Circular economy - Health and Safety Awareness/Legislation and regulations	- Organising and planning a business - Team working negotiation and conflict management - Applying principles, policies and regulations of health and safety in the workplace - Conscious decision making	- (Animal) Disease management - Food fraud - Food safety	
Denmark Reason	Additional training in systematic data collection would add to the reduction of biases and random errors. - Data collection is essential in any project. This skill is needed in order to avoid situations where time and money have been spent and incorrect data, or data with no means have been collected. - This skill will help veterinarians to analyse large datasets that may not be visible through traditional methods.	This skill is missing from Danish bachelor's training, so Danish veterinarians need more training on this skill. - Sustainability agenda is central to business strategy. - It is crucial that circular economy approaches and sustainable green process productions are being promoted at farming level. Veterinarians have to be informed about these approaches. - Additional training in this skill would ensure that all	Training in this skill will help veterinarians learn some basic economic principles related to their business or to the business they consult. - This skill is essential to help a business function successfully by ensuring operational efficiency. - Veterinarians need team working negotiation and conflict management skills to ensure that team working turns out in a win-win situation. Using these skills, professionals are better equipped to learn	It's important for veterinarians to focus on human health more, and make sure that farmers produce healthy products for humans. - This skill will add great value to veterinarians' critical role on environmental protection, food safety and public health. They are very often called to report diseases that they have never seen before, and that's high on their to-do list. - Fraud awareness training helps increase the	Process optimization is important to veterinarians because the main goal is to make the production process as fast and efficient as possible, and simultaneously, eliminate excess waste. - Not all Danish companies have their own in-house experts for the implementation of new legislation. Veterinarians are called to add this skill to their competencies.

	Food processing technical skills are very useful now that Food legislation and animal health legislation are related to risk assessment in the food businesses - This skill offers the necessary capability to design and operate AI applications at scale.	veterinarians are aware of the current national regulatory framework.	from and teach others in an effective way. - It is important veterinarians follow the latest regulatory framework of health and safety, as they need to minimise spreads of bacteria, animal diseases etc. - This soft skill is important to veterinarians because they often have to make decisions fast.	effectiveness of the anti-fraud controls and ensures that anti-fraud policies and reporting protocols are followed. - Veterinarians' contribution to one-health approach will be empowered when professionals will be more aware of the importance of food safety.	
Germany skills	- Big Data knowledge and handling - Telemedicine - Accessibility of data / structuring of data	- Basic understanding of bioeconomy - Impact on circular economy through medicines - Life-product cycles of animal husbandry / holistic marketing - Bioeconomy as tool for farmers - agricultural systems	- Entrepreneurship / Business - Practical skills in running businesses - Investor acquisition - Practical skills / soft skills - Work-life balance	- Expertise on infectious diseases - Competence in the use of antibiotics - Infectious diseases - Ante-mortem and post-mortem meat inspection	- Veterinary medicine as a consultant - New concepts of vet care
Germany Reason	- Linking of existing data about animals to make statements about animal health. - diagnostics, quality improvement (radiological	- First of all, people need to understand the concept of Bioeconomy. - Understanding the impact on the circular economy through medicines.	- It must be highlighted again, that business and entrepreneurship skills play up until now no role in teaching in the vet sector.	- Depth of expertise taught on infectious diseases not sufficient. - Skills needed on the competent usage of antibiotics.	- Vet sector becomes more and more important as consultants for farmers, not only as their doctors. Education of consumers. ⬜ integrated veterinary stock supervision

	evaluation from a distance) - Data in itself is of no use if you can't access it.	The price for life within animals must be seen again also for restoring social acceptance. Therefore, life cycles of animals must be considered. Another important aspect is a holistic marketing of animals and meat. - Bioeconomy as a basis for competent advice regarding farmers - Skills in agricultural systems are often insufficient with people working in the vet sector.	- Practical skills concerning practice set-ups and tax issues should be taught. - Many practices and business in the sector are taken over by investors, compared to human medicine. Skills need to be taught on how to deal with such acquisitions. - Practical and soft skills are often lacking and lead to increasing dop-out rates - Much stress, long working hours and often incompatibility with family.	- Skills with the handling and awareness of infectious diseases and their impact on humans. - Skills in meat inspections are important since they can be the starting point of many diseases.	- Medical care centres
Greece skills	- Continuous re-skilling & up-skilling - Digital analysis for animal movement and remote data collection. - Use of basic digital tools - Knowledge of platforms related to the legislation and operation of automated machinery. - Technologies for production monitoring	- Up-skilling & re-skilling - Food legislation - Animal Welfare - Concept of Sustainability	- Teamwork, Negotiation, Personnel management - Continuous Learning - Ethics - Communication Skills (written or oral). - Ability to listen to the needs of society.	- Interdisciplinarity - Existing knowledge enhancement - Upskilling for the lower-level workforce. - Animal feed and nutrition	- Prevention of animal health risks - Food legislation - Animal welfare & certified skills - Team management

Greece **Reason**	- Lack of training, misuse, and the gap with older generations. - Automatization and instant identification of a problem (e.g., disease) - Data collection and analysis from all workers - Awareness on new laws and regulations - Direct monitoring and a priori detection of different animal issues (e.g., diseases)	- Lack of training in this field, from the university. - Slow transition to this concept. - The food industry is dynamic and constantly evolving - Nobody certifies this knowledge until something becomes mandatory, we don't usually implement it; delay in implementing EC 1099 legislation. - New terminology for the Greek standards	- Proper staff management and integration of the employee into the team - There are no training materials in universities (soft skills). - Respect towards animals - Not included in the educational guide of the universities (soft skills). - There is no systematic training in academia.	- It is important to include knowledge about animal & human nutrition - In-depth, rather than superficial, knowledge of one health related issues - Under-qualified workers, especially older ones, are not even aware of the concept of one health, in order to be able to contribute in this direction. - In order to keep up with the new animal feed and to acknowledge the nutritional value of each one.	- Monitoring and observing animals with the ability to instantly identify a problem. - Need to get familiar with food legislation while food processing is linked to veterinary activities. - Certification of animal welfare in terms of animal handling skills and the ability to pass on the concept of ethology to other veterinarians. - Team organisation and coordination. Leadership skills.
Italy **Skills**	- Health and Safety digital tools - Evaluation of Animal production procedures - Integration of Data Transfer Systems - Machine and Smart-application - General ICT skills	- Supply chain inspection - Biomass and Biofuel - Animal Health Certifications - Epidemiological monitoring - Basic Zootechnic notions	- Emotional Intelligence - Networking - Managerial tools - Communication - Veterinarian team building	- One Health Approach Knowledge - Supply chain veterinary - Conscious choices - Opportunities offered by AI - Veterinary interested in human health	- Emerging technologies - Food systems - Process optimization - Environmental footprint of agri-food products - Animal Welfare
Italy **Reason**	- Acquire a general view of the veterinarian who is actually seen only as the one who treats pets, while playing a key role in the health and safety fields, for this reason students also need to be directed in	- A focus on the crucial role played by veterinarians in the food supply chain. Supply chain inspection skills allow them to ensure the quality of the food products. - These skills are particularly valuable in animal waste	- Emotional intelligence plays a significant role in animal handling and stress management and coping with difficult situations. Its application in the veterinary sector contributes to better client	- The approach mobilises multiple sectors, disciplines and communities at different levels of society to work together. This way, new and better ideas are developed that address root causes and create	- The ability to use emerging technologies is necessary to have workers integrated with the processes of the time. - Knowledge of food systems is an important skill for animal care and

	advance to digital safety tools. - Students needs to learn of the most concrete animal production activities in the field. - Integration of data transfer systems is critical and needed. - Take advantage of technological advancement in the veterinary field as well. - Need to better manage general digital aspects.	management, allowing veterinarians to efficiently utilize biomass, such as animal waste, for the generation of biofuels or bioenergy. - Questioning the usefulness of postgraduate certifications. - While specialized certifications hold value, general animal health certifications may be seen as redundant within the existing framework of veterinary qualifications and regulations. - Focus on the connections between human medicine and veterinarian activities. - Basic zootechnic notions are essential in the veterinary sector as they provide veterinarians with the knowledge and skills necessary to effectively care for animals in different production systems.	satisfaction, enhanced patient care. - Through networking it's possible to create interconnection, collaboration and knowledge sharing. - Managerial tools address the journey of veterinary technicians as they step into a managerial position, highlighting the need to acquire and cultivate the necessary skills to excel in their new role. - Promote effective communication as much as possible can create a supportive work environment for veterinary professionals. - knowing how to collaborate crosswise to enjoy the veterinary sector.	long-term, sustainable solutions. - The knowledge and opportunity to influence the entire supply chain in order to ensure the health of animals, the environment and humans - The ability to fully understand the choices you make and all their consequences for animals, humans and the planet - AIs create exciting new opportunities in the world of human and veterinary medicine - Knowledge of animal diseases that affect humans but also the health of the planet.	also for the one health approach. - Process optimization must be known in order to continue to treat and keep animals and their products under control. - Attention to environmental sustainability for better, healthier and more responsible production. - Animal welfare as the main guide for working closely with production and industry.
Portugal Skills	- Big Data - Data protection - GIS systems for animal control	- Organic Livestock - Alternatives to antibiotics and antiparasitic - Soil microbiology	- Communication with the public - Communication with the customer	- Antimicrobial and antiparasitic resistance - Principles of epidemiology and surveillance	- Traceability - Environmental footprint of agrifood products - Emerging Technologies

	- Electronic prescription - Telemedicine	- Carbon cycle and effluent recovery	- Economic management in the own business - Social media - Deontology	- Emerging infectious diseases - Risk management, (including crisis and risk communication) - Knowledge of animal behaviour / Management - Policy and legislation related to "one health" - New treatment approaches	- High level of specialisation - Quality control
Portugal Reason	- Concept related to the use of a large amount of information. important to deal with the large amount of information available to use in future decisions - Important because veterinarians use many personal data and data from the farms - Technology is increasingly cheaper and very useful to remotely control animals and manage the pasture. - Important to respond to the new legal requirements - New trends. Makes medicine available in remote places with less cost.	- Organic livestock involves the organic production of feed. - Related with the welfare - Each time more in necessary to work with the soil microbiology - Look at the cycle of carbon to be more efficient	- Communicate with an increasingly urban society what is agriculture and livestock and why agriculture is important - Communicate with the customer the service. Marketing the service. - Crucial the management basics for the veterinarian business - Very important to know how to communicate and avoid misunderstandings - Very important for a correct practice of the profession	- Important trend for the future - Summarises many of the issues we raised - How to deal with the risk of emerging diseases - biosecurity - Link with the previous issue - To know how to deal for animal containment and handling, ensuring animal welfare. When we leave university, we don't know how to do it. - Very important issue. We all complain about not knowing much politics related to "one health". - Within classical medicine we have to approach treatment including other	- Important to evaluate the quality control. - Had been spoken previously in the sustainability but is a specific skill trend - Very important for the future of the profession - It is a new trend. Linked also with the emerging technologies. - Linked to the traceability

				issues, such as economic ones.	
Slovenia Skills	- Food supply chain (knowledge of production and control, traceability) - Basics of digitization - Technical skills for food processing: HACCP - Use of software and applications	- Animal welfare and the prudent use of antimicrobials - The role of Health and Safety Authority - Good agricultural practices - Digital technologies in agriculture - Gas Emissions - Biodiversity - Water	- Basics of ICT knowledge - Lifelong learning and continuous learning - Teamwork, negotiation and conflict management - Communication with consumers, Organization and planning - From traditional to digital food marketing	- Animal health and welfare - Antimicrobial resistance - Public health - Disease management - Food and feed safety/ Food and water safety	- Animal welfare - High level of expertise and Future Farming - Labelling and food information for consumers - Food Systems and Agricultural Policy
Slovenia Reason	- The fields of biochemistry and microbiology are increasing, a high level of knowledge is required.	- it must become an independent competence, as it would have a tremendous impact on the entire agri-food industry in the future - For the traceability purposes - Greenhouse gases - Effects on animals	- an important basis that includes all of the above	- N/A	- Agricultural policy, the most important modern trend - in the implementation of official control, not only knowledge of the regulations but also knowledge about it also important from the point of view of lifelong learning - What will food systems look like in the future? - Politics also affects the farming of the future
Spain Skills	- Digital technology for food safety management: traceability. - Optimization of animal production.	- One Health approach in sustainability and bioeconomy. - Control of livestock waste. - SANDACH management.	- Quality management systems for veterinary companies (audits...) - Business management and human resources.	- In-depth knowledge of the One Health concept. - Antimicrobial resistance and alternatives to antibiotics (just like pesticides)	- Business and team management - Quality certification systems

	- Creation of transdisciplinary databases as well as management systems integrating data from different sectors - Biomarkers, and biosafety markers	- Management of sustainable agricultural and livestock residues production of insects and proteins of entomological origin. - Aquaculture, apiculture and pollinators. - Applied bioeconomy for sustainable small animals and pets' business. - Biodiversity - Health plans by veterinarians of livestock farms. - In good practice in agri-food industries: Veterinary activities are not well detailed - Pesticides or phytosanitary products by veterinary prescription	- Health plans at the workplace in veterinary companies. - Welfare and management of animal production. - Communication - New business models trends: animal-based therapies - Expert reports and associated legislation, and preparation of technical reports. - In marketing: knowledge of quality figures in the livestock	- Emerging pollutants from One Health point of view. - One Health as a farm-to-table management model. - Adaptation to climate change	- Prevention of occupational risks and specific aspects of biosecurity. - Project Design - Court reports - Advances in new issues applied to veterinary activities.
Spain Reason	- Digitalization applied to food production in order to manage traceability to implement quickly measures that ensure food safety - Development/use of biosensors joined to Artificial intelligence. Biosensors allow us to collect data continuously on animal welfare and their environment.	- One Health should be the key pillar for the development of all competences in sustainability and bioeconomy. - Waste control: is important to find new uses for both to protect the environment and to strengthen the circular economy.	- There is a need of knowledge about procedures that should be followed to maintain a good quality system and consequently control to accomplish with legal matters - In companies with veterinary activities requires detailed knowledge of job functions in order to effectively and	- Redundant terms are detected in those indicated for selection. Focussed mainly on human health. - There is an urgent need to limit the use of antimicrobials that cause resistance in animals and humans that may cause serious illness and in some cases death.	- Veterinarians need deeper knowledge and training on business and team management. There is not enough education in this area applied to all veterinarian professional activities. - Veterinarians are familiar with quality systems for food safety but not in all areas of expertise and it is

Information from integrated data in the animal production chain is essential for fast and right decisions in due time. Also important is to design compatible databases that can integrate data from different sectors/areas. - The creation of databases and software applications would make it possible to perform predictive models and/or notify the corresponding sensitive sectors. - Knowledge of programs to be able to make prescriptive models with databases, also useful for performing predictive models in different areas. - Development/use of Biosensors joined to Artificial intelligence.	Impact on human health from wild ecosystems or peri-urban ones: invasive species, emerging diseases, and their impact in animal and human health. - It is important that professionals know how to prepare health plans considering everything from animal welfare to waste control and environmental protection. - Veterinarians are responsible of the sanitary control and food safety in agri-food industries also in intermediate transformation of animal products intended for human consumption - The World Organisation for Animal Health considers an animal to be in a good state of welfare if it is healthy, comfortable, well-nourished, and able to express innate behaviour and not suffering from pain, fear, or distress. - A way to control the use of these products. Generally, they are used without control in plant	efficiently allocate and manage human resources. Psychosocial factors due to burnout in the workplace or the abusive use of psychotropic drugs are not taken into account. - There are extensive regulations that cover all stages of animal and food production with specific requirements that must be differentiated and objectively assessed. - There is a lack of soft skills in communication development. - Knowledge about different animal-assisted interventions: therapies, social, educational - Need for knowledge on how to prepare projects, procedures that entail both external and internal audits, expert opinions, certifications and regulations increasingly linked to self-control mechanisms - This knowledge can redirect the animal production to obtain this type of qualification	Biological contaminants are more or less controlled, but chemicals are a vast and changing spectrum of pollutants. - All stages of food production, distribution and handling must be in balance and assess their risks and their management. - New climate conditions can change, for example, the selection of productive animal breeds more adapted to the environment, the appearance of new species that can reach ecosystems, etc.	needed to cover specific areas. - In large-scale production, the prevention of diseases/risks is a priority matter rather than their resolution - Knowledge about design projects taking into account analysis of resources, team, financial matters and so on. - Knowledge about legal communications. To know how to write expert reports or expert appraisals - Biotechnology, biodiversity, robotics, are growing areas that can not fully know their potential application to veterinary activities.

		production, and they may cause residues or toxic effects in animals	figures that gives added value to the product		
The Netherlands Skills	- Data analysis, selecting useful data. - Recognition of deviant data - Measurement of emissions - Ability to spar with external parties about information. - Connecting information around the theme of food security - Integration of data from farm to shop	- Waste management on farms - Drug use management - GMP/basic awareness of sustainable practice - Knowledge of alternatives of drug use. - Integral approach of opposing measures - Fire preventive measures in modern housing - Safety and health of workers around the farms	- Systematic working skills - Communication skills - Awareness of reliability of information, and variation in measurement - Safety in the workplace	- Interpretation of diagnostic tests (SE/SP) - Zoonotic Diseases (in broader sense) - Therapy loyalty (administering, completion etc) - Diagnostic monitoring of animal health - Handling of specific animals / behaviour	- Use of social media, danger of mis-information - Chain forming in the veterinary sector. - Anglo-Saxon business model vs Rheinland model
The Netherlands Reason	- There is a huge amount of data available from all the sensors on the farm (sensors of cow, milking robot, feed robot, etc.), but little skills to analyse it and use it to manage. - In relation to the above: as there is so much data available, deviation is unnoticed, especially when it needs an interpretation of the relation between various data inputs. - Farmers are too dependent on regional measurements of emissions which are	- Awareness of risks of waste management (feeding of to calves, or waste through sewer). Input of Ant - Connection to the above: as soon as drugs are prepared for use it is bound to end in the environment, either through the animal or through waste. Limitations of use are mandatory. - Basic environmental awareness of being a professional food producer. Realisation of the need of sustainable	- Working systematically, according to protocols, or according to agreements is important for quality and food safety. - Communication skills are still not sufficient, especially listening and reading provided information to an analytical level is insufficient still. - Statistical knowledge to a basic working level is necessary to be able to see variations in data as a result of a cause and as a random error. And skills to	- As to one health interpretation of diagnostic tests and its sensitivity and specificity is necessary to prevent wrong decisions in disease control - 70% of all human diseases are eventually zoonotic. So in a broader sense knowledge of risk and control of zoonoses is very important. - Importance of loyalty to therapy of antibiotics and other drugs is not too common knowledge. This	- There is an information storm amongst young people. It is very hard to select useful information from the ocean of information getting to them. - There is a growing chain forming in the veterinary sector (Evidensia, Anicura) or even integration of services. This may lead to increase of costs due to improved possibilities for advanced diagnostics. This needs more awareness. - Anglo-Saxon business model, market driven vs.

interpreted by (semi-) governmental parties. But farmers can't use that to manage and optimise their own farms. They need knowledge of that by themselves. - A farmer plays a role in food production and therefore needs to be able to communicate with other parties in the product chain. - All parties in the food production chain must be able to connect information around the theme of food security. Food security is an effort of the whole chain. - Chain organisation and chain information management in the chain. Which is an initiative of a company with sufficient market power with skilled staff to organise the chain.	practice in the food production - The key to decrease drug use through skills of farmers to manage disease prevention alternatively. - Some measures are opposing each other. For example: animal welfare demands free range poultry but that increases air pollution (micro particles). It takes good skills to manage that well. - In the last decade, there have been many devastating fires in modern poultry housing caused by sensors and controlling units in a fire sensitive environment. - Farm workers and family members have elevated risks for health and safety: Zoonoses, injury by animals or equipment.	select information from reliable sources - Especially on farm level there is too little awareness and skills to record events or decisions for later use in management. So farmers should get more skills in recording observations in a way that may be used later. What can be learned from the recordings (soft data). - Farms are in the food production chain more susceptible to injury and death of workers than other companies. Training of safe working is important. Basic skills of safe working.	needs improvement in the sector - Methods of monitoring animal health and wellbeing is an important issue. What tools of diagnostic monitoring is available? - In order to prevent injury on farms training of what is the correct way of handling and approaching animals to prevent injuries. This includes training in knowing animal behaviour.	Rheinland model, content driven. Anglo-Saxon model is not helpful in times when sustainable production is important.

6.3. Food Industry

Table 6 Urgent skills needs fostered by the COVID-19 crisis, emerging technologies, green and digital transition in the food industry sector divided by country

Country/ Skills	Digitalisation	Sustainability And Bioeconomy	Business-Entrepreneurship and Soft Skills	One Health	Sector Specific Skills
Austria Skills	- System integration and data transfer: Skills on Industry 4.0 System - Solutions - Skills on computer-validation - Classification for IT-competences - Robot applications in smart farming (e.g., drones)	- Circular economy: General rethinking - Linkage of food technology with sustainability - Circular economy: Calculations regarding energy savings vs. food safety - Sustainability and biomass/biofuel	- Be up to date with and react to actual development of the necessities of workers/employees - Leadership as a motivating factor - Innovation management/business modelling - Cybersecurity	- New emerging food safety topics related to changes in agricultural cultivation - New nutrition trends and effect on allergen labelling - Insects as food – pros and cons from a holistic approach	- Innovation in product development - No lack of skill in quality control - In Austria: enough competence in packaging
Austria Reason	- Industry 4.0 is virtually non-existent - There is a trend towards the digitalisation of process parameters that are relevant for quality and food safety. Legal requirements require the proof of sensitive data (data which is relevant for food safety and GMP) – this data must not be manipulable in retrospect. There is no competence in the food sector for this. There is no training.	- Circular economy is no longer avoidable – a general rethinking is required - Increasing demand of stakeholders and standards for sustainability in food industry – but quality managers do not have corresponding knowledge - Introduction of circular economy in industry requires calculations and estimations regarding food	- Change in the needs of employees: general search for staff - the employer must react - fulfilment of needs (must reflect company) - Identify and meet employee needs - Creating a bond between employees and the company would create retention of workers	- General change of diet: we save environment - but this may have effects on immune system - Due to the incorporation of new production lines in traditional (e.g. milk) processing factories new allergen labelling topics can occur - New protein sources must be considered from a holistic approach	- Energy prices are high, raw materials are scarce, yield should be higher, i.e. the goal would be less waste, more yield, less energy needed. As an example: there have been ideas, how to bake bread without this big problem of energy consumption. - There may be a shift in priorities for food production due to climate change. - In Austria: product development is strongly

	Students have very different previous knowledge; it is difficult to find the starting point here Robot solutions, especially on a small scale, can contribute to resource savings and be a more economical solution: one could e.g. replace the use of his tractor when doing specific small field work. Could also be a possibility for the Harvesters problem (that there are too less harvesters – German term: "Erntehelfer")	safety – responsible people do not have these required skills EU gives discussable opinions			designed around customers and markets needs - Packaging is a huge topic - food labelling is dictated by law of the country of destination – FG-participants do not see food labelling as a sector specific trend. - Food information for customer: is partly dictated by law (how and about what as to be informed). - - In Austria we are well positioned regarding trainings concerning these topics.
Denmark Skills	- Digitalisation basics - Data handling - Proper implementation of artificial intelligence	- Training in Policy and Regulations (global/local standards requirement) - Innovation in Circular economy - Ability to measure sustainability/European taxonomy to report on sustainability - Ability to market sustainability	- Innovation management Communication skills and negotiation skills - Diversity and Internationalisation Listening skills - Awareness of the entire chain (industrial operations) - Critical thinking/Adaptability - Entrepreneurship skills for employees' engagement	- One health related policy and legislation - Ethics - Perception of health	Environmental footprint of Agri-food products and its measurement

Denmark Reason	Strong qualification in digitalization basics skills will improve the finding of new solutions in food industry aspects. it is of great importance to have the same level of understanding of digitalization basics. Data should be collected and handled in a way to help professionals optimise the production. The efficient and appropriate use of artificial intelligence is an important aspect during training on digitalization. It's important for employees to know how to select between relevant tools.	SME's (Small Medium-sized enterprises) really need training and support in this domain. On the contrary, larger/well-established food companies have this knowledge. New innovations in circular economy, along with green skills will build into the Food Industry in Denmark. importance: a great number of Danish Food industries follow the EU legislation on waste managemant and the Farm to Fork strategy. Food industry sector should be aware of the need to be introduced to global and European standards and protocols and how to understand time space targets. Food industry sector lacks knowledge on how to market the sustainability of their products.	-Company management that combines innovative and traditional principles is very critical for the success of a food company. Good communication and negotiation skills are key elements for a good and internal operation and efficient external cooperation. - Internationalisation: practice of designing products, services and internal operations to facilitate expansion into international markets. Diversity offers a competitive marketing advantage to Danish food industries, which aim at exporting high quality, innovative food products. These skills are required in relation to marketing and export of foods from Denmark. -Listening skills help improve overall	Food industry professionals need to understand the legislative framework for health. This framework needs to be clear and understandable by business operators. The current concept of Europe moves towards the "one health and one assessment" approach. -Food industry professionals should give more importance to an ethical food supply chain. Supporting an ethical supply chain means that companies will have to incorporate social and human rights and environmental considerations into how they do business. An ethical company could also advertise and market it. Food professionals shall comprehend the diversity of Health perception in the different EU Countries. People in different EU countries assess subjectively what health	Certifiable and measurable environmental footprint of Agri-food products could be included on the labels.

			communication and build a better understanding. -Increasing awareness of the entire chain, food companies can identify inefficiencies, reduce waste and make better decisions. -Critical thinking guarantees objective and efficient problem solving. Adaptability enhances productivity. -Its importance is based on the fact that it brings innovation to every aspect of the food business by using resources effectively. They are vital for promoting innovation, business growth and competitiveness.	means. the importance of this skill lies in the fact that the above subjective assessment influences consumers' food choices, e.g. weekly meat consumption is higher in northern EU countries.	
Germany	- Traceability - Certification - Digital quality management	- Environmental impact with cleaning and disinfection agents / Refrigeration systems - Knowledge of potential hazards - Modernization of laws making substances available for use more quickly. Awareness of such laws / Competencies in recycling waste streams	- Basic language skills - Independent structured work - business skills - IT security	- protective cultures application - Awareness of the risk of diseases - water use/handling of drinking water - Integrative mindset	- Effects of production on nature - Regional production and consumption - International trade agreements - Raw material security - Rapid product development for better market response - Digital customs clearance

		Occupational safety			
Germany Reason	- Traceability is of great importance, not only because of legal requirements, but also due to consumer demand for this topic. Skills need to be trained there. - Digitalisation in the field of certification and quality management plays an ever-important role. - Quality management and new regulations will mostly be tackled digitally.	- It is important that workers are aware of environmental effects of certain agents to the water. - Laborers need to be aware of laws affecting side stream usage and valorisation. - Ergonomics and occupational safety are important.	- Basic knowledge in the area of foreign languages but also calculating and writing are decreasing more and more. - Workers are increasingly in need for ever detailed work instructions. Independent working as a skill needs to be trained again. - There is a lack of those skills in education. People need basic entrepreneurial skills concerning their company. - Cyber security becomes a bigger threat. Awareness of this danger and how to handle data safely must be trained. - People need skills in conversation management and customer care.	- prolonging shelf life, preventing the growth of harmful organisms, against zoonoses - supposedly extinct diseases that break out in disaster areas - It is important to see water as a resource, but also as a potential vector for diseases. - People need to understand the interdependencies between the areas of the one health concept and their dependencies.	- Nitrogen in particular is a hot topic in many European countries. - Regional production is important. Economically and environmentally, but what exactly is regional? - Understanding the impacts of trade agreements and their market opportunities Skills do quickly and adequately response to ingredient scarcity. - Skills for quick product developments are important against the background of raw material security but also against the demands of costumers (food health and animal welfare). Skills needed to quickly react to market demands. - For efficient export, skills in digital customer clearance is important.
Greece Skills	- Knowledge of Industry 4.0 capabilities - Data analysis	- The practical aspect of sustainability - Sustainability concept sustainability sectors	- Business plan - Human resources management	- Animal health & animal welfare	-

	Technical knowledge of online tools - Data Management - Use of machines with the ability to extract data (indicators) - Digital reporting	Sustainable development/growth - Valorisation - Targeted knowledge	(entrepreneurship) Boldness - Analytical thinking - Continuous learning - Basic entrepreneurship		
Greece Reason	- Driving force for a faster and more immediate transition to Industry 4.0, which also leads to the digital transition of the sector. - The tools for data collection exist but there is no knowledge of how to analyse them to make the most of them. - Especially training with these tools can now be accelerated and facilitated. - It mainly refers to large companies that want to cope with international markets through new ways of ordering or communication through platforms etc. - Simplified and immediate export of indicators relating to the production line. - The international market is increasingly using the exchange of information	- Sustainability is now a core part of the European Commission's regulations. - The concept of sustainability refers to both the staff and the executives of a company coping with the demands of the business. - In order to enhance knowledge, the various applications/ fields of sustainability must first be identified. - To help us and the food industry, in general, understand the importance of ESG we need to become familiar with this sector in order to cope with the demands and developments in the international market. - Targeted and relevant knowledge relating to the person's age and job position that will help to	- Key knowledge for developing a business idea. - Contributes to the productivity of the individual and the development of the company in general. - People with a bold approach to entrepreneurship will help to almost eliminate the hesitation that exists mainly in large companies - Need for people not only with knowledge, which can be built up through experience but also with the ability to solve problems. - Important for both individual and collective (as a company) development. - There are opportunities without knowledge to support the development of entrepreneurship.	- A critical factor for evaluating suppliers	- N/A

	through platforms (online) and it is a skill, essential, to cope with the requirements.	integrate sustainability in everyday life and at the company level will bring profits/benefits when employed by these people			
Italy Skills	- E-commerce - Supply-chain harmonised management - Resource efficiency software (e.g. water management) - Neuromarketing - Emotional intelligence - Artificial Intelligence - Market Analysis - New analytic tool	- Nutraceutical and biotechnologies - Waste prevention - Corporate Social Responsibility (CSR) - Management first input (water) - Efficient management of supply chain	- Communication - Management of digital skills - Lifelong learning - Team working - Critical thinking - Sense of responsibility - Leadership - Organisation of activities	- Food Safety - Food security - Sustainable diets - Food Culture - Food waste prevention	- Logistic skills - Labelling policy & consumer information - Novel foods overview - Advocacy - Certifications
Italy Reason	- The demand for safe, healthy, fresh and local foods have boosted new short food supply chains and the development of digital business., enabling food producers to interact directly with consumers or restaurants. Online business can increase sales volume. - The need to get harmonised supply-chains was even more clear after years of COVID-19 pandemic and also after Ukraine invasion by Russia.	- A link between these two areas would be crucial to really exploit all changes coming from new consumers' trends. Their interaction could be useful also to fight against climate change. - From raw material to packaging, a better management of these resources is advisable to embrace and boost sustainability transition. - Corporate Social Responsibility groups together different areas and topics; it should be	- Successful communication flows are essential to make things go smoothly within networks and businesses. It is necessary to be able to really read analytic data, with a broader approach. - Spending time on training during the career is a key aspect when the worker/entrepreneur is fully oriented towards a good management of its resources and future vision. - To thrive, a production system must necessarily be	- Ensure food safety is of the principle at the basis of food & beverage industry, and it is also an important aspect from a One Health perspective - In a world disrupted by global pandemic and conflicts, ensuring food security has become even more important today. - Making healthy food choices for sustainable eating behaviours can also help promoting people' health and wellbeing, while trying to move forward greener paths	- Global supply-chains, like food & beverage, need to be highly skilled at each level of the structure. Moreover, it has to be interconnected to fully be able to face disruptive situations (such as, pandemic) - Being always updated about mandatory information to be displayed on labels - Being updated about novel food and new consumer trends could be a sector specific skill for those food & beverage professionals

	- Droughts and other climate-related problems make it clear that we need to adapt and update our digital and engineering knowledge. - In the world of food, where feelings/tastings make all the difference, neuromarketing techniques are very important. - It can help food industry professionals to navigate complex decisions. - Useful to try to prevent crisis or to anticipate wrong behaviour in a company. - They are crucial activities, which must be followed by a proper grounding. - An ongoing search for updating existing digital tools is at the basis of the process to be able to face new scenarios.	widely embraced by companies to - Best practices should be shared to improve the management of first input, such as water, in order to protect the environment and specific resources. - Delivering specific quantities of products, and collecting raw material always in a more sustainable way.	based on shared activities and teamwork. - In order to have the possibility of harmonizing all skills, critical thinking is essential: it gives professional the proper way and feeling of merging activities together. - Sense of responsibility is of the core aspect for successfully managing a company or getting positive results within interconnected production chains: it should be respected towards consumers, workers, Institutions and so on. - To face complex global issues, leadership is crucial to lead a business in the right direction. - Well-scheduled activities are at the basis for a successful company.	- Spreading a food culture harmonised with sustainable production systems ensures environmental benefits and one health improvement. - Food systems and one health approach both embrace best practices to reduce food waste.	who work in particular segments of the supply-chain. - Lobbying and advocacy are very important skills especially for food & beverage professionals working with Institutions or unions. - Professionals of the food and beverage sector, working in specific segments of the production chain, should be fully aware of certifications needed.
Portugal Skills	- Technical skills for food processing - Food supply chain - Operation of typical machines, robots and applications in smart farming	- Circular economy - Good agricultural practices - Water - Air and atmosphere - Good practices in the agri-food industry - The changing workplace	- Organization and planning - Safety and healthy workplace - Teamwork, negotiation and conflict management - Leadership and communication	- People's health and well-being - Risk management - New sources of protein - Counterfeiting of foodstuffs – Food fraud - Food and water security	- agricultural policy - Process optimization concepts and technologies of Industry 4.0 - food systems - Environmental footprint of agri-food products

	- Basics of digitization - System integration and data transfer	- Innovations in the bioeconomy - Health and safety awareness	- Lifelong learning and continuous learning - From traditional to digital food marketing - Innovation management	- Food and feed security - Packaging and food contact materials - Animal health and welfare	- quality control - emerging technologies
Portugal Reason	- familiarity - the importance of newer technologies, the importance of packaging - Advanced development, using skills - cooperation - food safety	- Waste processing - Climate change, primary production, which affects the quality of products - increasingly frequent dry periods - Drought periods, footprint - Climate change, food safety - lifelong learning - Marketable	- workplace difficulties, accident prevention and use of safety equipment - The importance of leaders - Exchange of good practices - Relationship between the product and the consumer	- Human at the center - Consumer protection	- Important basis - Information for consumers legislation - Farming the future
Slovenia Skills	- Technical skills for food processing - Food supply chain (knowledge of how the food supply chain works) - Operation of typical machines, robots and applications in smart farming that affect the production of raw materials for the food industry - Basics of digitization - System integration and data transfer	- Circular economy and waste procesing - Good agricultural practices that affect the production of raw materials for the food industry - Water management - Air and atmosphere management - Good practices in the agri-food industry - The changing workplace - Innovations in the bioeconomy - Health and safety awareness	- Organization and planning - Safety and healthy workplace - Teamwork, negotiation and conflict management - Leadership and communication - Lifelong learning and continuous learning - From traditional to digital food marketing - Innovation management	- People's health and well-being, welfare - risk management of foods and new ingredients - new sources of protein - counterfeiting of foodstuffs – Food fraud - Food and water security - food and feed security - Packaging and food contact materials - animal health and welfare	- agricultural policy - Process optimization concepts and technologies of Industry 4.0 - food systems - environmental footprint of agri-food products - quality control - emerging technologies

Slovenia Reason	- Familiarity, knowledge of equipment, technology - the importance of newer technologies, the importance of packaging - Advanced development, using skills - cooperation and transfer of information between generations - this affects the entire field of food safety, including communication with consumers	- Waste processing as an increasingly important factor of the entire circular process - Climate change, primary production, which affects the quality of products - increasingly frequent dry periods - Drought periods, footprint - Climate change, food safety - lifelong learning in the field of new strategies and orientations of sustainability - Marketable in terms of innovation - this affects the entire field of food safety, food safety culture	- how organized the individual is and how he can plan his work and the work of the team - workplace difficulties, accident prevention and use of safety equipment - the importance of teamwork to achieve the company's goal and results, as well as individual satisfaction - The importance of leaders - Exchange of good practices, communication, cooperation, transfer of knowledge and skills - The relationship between the product and the consumer, how an individual can influence consumer information in the modern world - innovation management, patents, intellectual property	- Human at the centre of one health - management of innovations in all areas: legislation, strategies - the importance and role of new protein sources in human and animal nutrition - Consumer protection importance and knowledge of the field, innovations that are coming both scientifically and legislatively - importance and knowledge of the field, innovations that are coming both scientifically and legislatively - importance, knowledge and management of the field - importance, knowledge and management of the field	- Important basis knowledge of the subtleties of process optimization - importance, knowledge and management of the field - functioning of food systems, meaning of the information for consumers - new legislation and knowledge of the method and importance for sustainability - quality of products, processes, company - new technologies in the field of farming of the future that affect the food industry
Spain Skills	- Sector specific digitalization - Cybersecurity - Data analysis - Digital marketing - Software Developer/ Management - Management abilities	- Eco-certification procedures - Optimization of resources focusing energy and water - Shift work in production - Transparent traceability information to foster sustainability	- Shift work - Commitment of workers and young generations social skills - Social skills for middle managers - Motivation for workers - Sensitive information management	- Healthy, sustainable, and personalised diets - Novel Foods/plant-based food - Labelling and new challenges - Intestinal microbiome - Risk management	- Environmental footprint of agri-food products - Agriculture policy - Packaging and food contact materials - Raw material supply management - Industry 4.0 concepts and technologies

			Generational transition Resilience and innovation		Food contaminants and incoming legislation
Spain Reason	- Digitalization courses give general tools for solving digital issues applied to any sector. Specificity will result in less time spent on activities that won't improve skills related to the food industry. - In Industry 4.0 applications, cybersecurity training is required for those who use them to protect sensitive information. - Digitalization allows to collect a huge amount of data but once collected analysis of results is needed to interpretate them for further decisions. - Digital marketing has become increasingly important because of how accessible digital channels, allowing companies to target a more specific audience or larger one. - Real need of training to design/use programmes/tools applied in the industry. - Scale digitalization to all actors in the supply chain.	- Eco-certification offers the guarantee to consumers that the methods used to obtain organic food comply with European organic production regulations. The path to obtain that certification is unclear most of the times. - One of the industry's main objectives in terms of environmental sustainability is the reduction of its environmental footprint and this includes energy efficiency and the reduction of water consumption. - Benefits for a company that employs shift work in production processes are increased productivity and revenue, thus ensuring sustainability. - As food supply chain become more complex, digitalization needed but the importance of food production transparency increases, clear traceability information needed.	- Industry using shift work improves their results. However, it may not be attractive to workers, who must find some motivation or advantage in this way of working. - Companies are often looking for employees with high engagement, thus will contribute to the success of their organisations. Important to provide a framework for consistent decision-making, creating connection through shared values and inspiring employees. - Middle level managers build relationships with those at the top and with staff at the bottom. They must be trained to achieve these skills. - Employee motivation is the level of commitment, energy, and innovation that a company's staff hold during the working day. Maintaining and improving motivation in the workplace can be a problem for many	- A nutritionally balanced diet is essential for the body's metabolic needs and is increasingly required by the health-conscious consumer. - Knowledge needs in relation to all innovation in new products with new ingredients and to the use of new proteins. - Information needed about Food Policy mainly related with Labelling of Novel Foods. Adapted/updated training related to it. - The intestinal microbiome plays an important role in digestion and keeping the immune system healthy. That is the reason why is becoming a more important matter to take it into account in food ingredients for health reasons. - Risk management is an important tool to allow a company to identify and deal with potential risks. Once a risk has been	- Importance of knowing product environmental footprint for environmental sustainability reasons. Need of training related with information about PEF calculation, interpretation of results, and ways to reduce it. - Agricultural policy structures how food systems operate. Policy supports food production, sets food quality standards, provides incentives for certain farming practices, and helps insure farms against crop losses. Policies are important in providing guidelines and directions to be followed. - Training needed on policy related to food contact materials, as well as regulation of plastics use in packaging and packaging in general. - Understanding of raw material supply management is crucial in food industry; ability to

			companies, as not every task will be interesting.	identified, it is then easy to mitigate it.	perform inventory control, reduce material waste, packaging.
	The growth of technology is exponential, so it's getting harder to keep track of emerging opportunities and maintain a full team with the same knowledge and skills.		- Information such as intellectual property, trade secrets or merger plans could be damaging to the company if they were to the wrong hands. - The generational transition must be managed correctly to get the best of both worlds. Artisanal techniques should not be lost, but it is true that without new technologies there is no growth. - Resilience and Innovation allow companies to adapt to market and consumer needs always evolving. Resilience is essential to accept new technologies.		- Food industry have benefitted from Industry 4.0 concepts by improving traceability, monitoring, and control of food quality; improving safety, manufacturing, automation, and training; predicting sensory and consumer preferences; and reducing loss and waste. - Need of being well informed about legislation related and incoming one.
The Netherlands Skills	- Knowledge and skills in PLC techniques - Integration of knowledge and skills through the chain - Communication skills in a technically challenging environment	- Lean manufacturing - Circular food systems - Researching attitude - Contribute to energy transition - Shortening of the food chain	- Safety consciousness - Auditing processes and purposes - Innovation and improvement (process product) - Cause-and-effect relationships within a	- Food safety and bio hazards - Nutrition and health relationship	- Using smart data - Management of change and sustainability - Flexibility and hygiene in food production lines

	Monitoring industrial Robots		production site (process-product relation)		
The Netherlands Reason	- Sector needs staff with "feeling" for the complex digital systems, able to adjust it, able to interpret data correctly and know what to do with intention with knowledge of the whole process. (not just press a button if a figure has turned red). - In a production facility everybody has to do with automation, but it has to be integrated with other knowledge such as process technique, or product properties etc., and at various places in the production process. - PLC systems demand a broad sense of ability to communicate on basis of information e.g. exchange of screen info, as well as actual sensory input as seeing hearing, smelling.	- Knowledge and skills involving application of the 5S methodology in the so called Lean Manufacturing method. - In order to move towards an circular economy, students should be stimulated to a greater consciousness of waste material and waste food. - Good skilled workers should be able to increase their knowledge by a researching attitude, noticing knowledge gaps and gather information to learn. - All skilled workers should know how to conserve energy and to know processing ways to reduce energy consumption. - In order to shorten the food chain employees	- In the food industry, safety awareness involves both employee and environmental safety. Within companies, tools and measurement methods are used to ensure safety. - Auditing processes is of ever-increasing importance for quality assurance. This involves different types of audits, some of which are legislation driven by international markets. Knowledge and understanding of this process is needed by all employees at the production line. - Taking a critical look at what you do/how you do it and whether it can be done differently or better. Continuous improvement. - This is not only about own part (process) but also the	- Food safety has become of utmost importance: temperature, hygiene, knowledge of salmonella, risks, abnormalities in e.g. the meat. - A skilled worker has knowledge of the relationship between nutrition and health	- To avoid errors, it is necessary for employees to be able to operate, control and monitor the entire chain. So that they are able to monitor the entire process, from cultivation to delivery to the customer. After all, through chain control, a fresh and fully traceable product can be guaranteed. - The future worker must learn to look on the "inside" of the chain: how is this, and how can we improve it? They have to learn to understand what the context is, analyze it, and then when that is adjusted, see what happens. - The "humanization" requires customer-focused action, to respond well to customer demand. This

- Being able to understand the process interpret the data and to communicate clearly with people from other backgrounds. Handle and communicate with remote assistance.	need knowledge of the entire chain. They must learn to think across disciplines and consider the entire system (suppliers and customers).	"other parts of the organization" e.g. maintenance process. Development from operating buttons to insight into machine and process		external focus requires a different, more commercial outlook from employees in the food industry. Increasingly, they are looking outward to respond to consumer trends or current events in society.

7. Trend in agri-food sector

The trend analysis in this report has taken as starting point a recent trend study from the Horizon2020 project Fit4Food2030 (Fit4Food2030.eu), in particular, deliverable 2.1: 'Report on baseline and description of identified trends, drivers and barriers of EU food system' (Wepner *et al.*, 2018). This extensive trend study was conducted through interviews with selected stakeholders across Europe, in-depth desk research and a European survey. Further, trends identified were in-depth discussed with European experts from different areas of the food system before these were finally selected. Fit4Food2030 identified 60 trends in and beyond the food system in the EU (Wepner *et al.*, 2018). These trends range from megatrends like climate change to more specific trends like the increase in the use of bio-based plastics.

We follow the definition of ''Trend'' from (Fit4Food2030.eu D2.1, page 4): ''A trend is a development or change over a long time, which is likely to affect society or parts of it after a few years. A trend cannot easily be influenced in a mechanic way by individual organisations, players, or nations. It is often a result of specific drivers or can be promoted by strong influencers. It becomes visible only in retrospective.'' Trend studies usually distinguish between megatrends and trends. Megatrends are defined according to OECD (2016), as ''large-scale social, economic, political, environmental or technological changes that are slow to form, but which, once they have taken root, exercise a profound and lasting influence on many if not most human activities, processes and perceptions.'' Trends, contrary to megatrends, focus at smaller, regional, or sectoral scale. Fit4Food2030 identifies 11 megatrends (Table 7) linked to Global socio-economic-technological developments.

Table 7 Megatrends identified by the Horizon2020 project Fit4Food2030

Megatrends identified by the Fit4Food2030 project	
Climate Change	Scarcity of Natural Resources
Malnutrition	Rise in Energy Consumption
Rise of Non-Communicable Diseases	Industry 4.0 – Digitization
Urbanisation	Big Data Analysis
Demographic Change	Economic Globalisation
Migration.	

These megatrends have been specified for their impact on agriculture and the food industry in the EU. For this, the Fit4Food2030 project distinguished the following categories: Agricultural production; Food processing; Consumer trends; Market economy, Retail and logistics; Packaging and waste; Policy and other trends. These categories included specific trends. (For an overview of all trends identified in the project Fit4Food2030 and for a detailed description Wepner *et al.*, 2018).

Table 8 Identified trends in Agri-food and Veterinary in Europe

Identified trends in Agri-food sector

Sustainability	**Agriculture:** Integrated pest management, Integrated nutrient management, Agriculture pollution and GHG emissions, Organic farming and extensive production systems, Animal welfare, Scarcity of natural resources (land, nutrients), Pressure on water resources, Biodiversity and conservation of eco-systems, Food waste and loss, **Food Industry:** Technologies to deal with food waste and loss, Circular production, Energy efficiency, Environmental footprint, Smart logistics systems, Clean and ''green'' label, Consumer diets
Bio-economy	**Agriculture:** Biomass production and transformation, Renewable energy, Biobased products, Resource-efficient technologies and reduction of losses, Circularity of production, Biodiversity **Food Industry:** Use of food waste, Circular production, Energy efficiency, Biomass transformation, Bio-based products, Bio-based packaging, new proteins
Digitalisation	**Agriculture:** On-farm applications (combined technologies), Integrated FMIS, Big Data analysis and Agriculture 4.0, Traceability of produce, Supply Chain information systems, new customer relationships **Food Industry:** Food processing control, Food supply-chain monitoring, Factory design and industry 4.0, Robotics, Digital twins and augmented reality, 3D Printing/additive manufacturing, new technologies in processing and packaging,
Business Models	**Agriculture:** Changes in farm structure, Multi-functional farms, Urban farming and Indoor cultivation systems, Health and food consciousness of consumers, Traceability, Short food supply chains and Local/regional products, **Food industry:** Complex consumer demands and new diets, Interaction with consumers, new logistics and e-commerce, Short food supply chains, Novel foods, New packaging

8. ESCO

European Skills, Competences, and Occupations (ESCO) describes, identifies and classifies professional occupations, skills and competences relevant for the EU labour market and the education and training sector. One of ESCO's main missions is to build stronger bridges between the world of education and training and the world of work, contributing to reducing skill mismatches and supporting the better functioning of the labour market.

The vision behind ESCO is the provision of a common reference language that could support transparency, translation, comparison, identification and analysis of the content of a qualification, thus helping to indicate how those relate to the skills and occupations needed across occupations and sectors. The ESCO Platform has been used in FIELDS project as a guide when working on the development of the occupational profiles and specific qualifications associated with these new profiles.

The work on FIELDS task 2.5: linking occupational profiles (identified in task 2.1) with ESCO, started at the end of 2021. Gaps in these profiles were identified in terms of their transferability to ESCO: which skills and knowledge concepts are not found in or do not fully match the database. This encompassed using ESCO's search tool to match the entries and consultation to make sure the findings in ESCO matched the profiles from 2.1 as they had envisioned. By engaging all partners involved in this work package, the profiles were reviewed and necessary modifications were made considering the ESCO formulations[1].

Some of the main feedback from FIELDS in terms of new skills and new knowledge concepts were grouped in different clusters. Mismatches**:** In some cases, there were mismatches between what was proposed by project partners and what could be found in ESCO. The label was not appropriate or it referred to other fields not covered by the project. Similarly with the description, some of them referred to general skills and knowledge concepts, whereas in some cases the profiles for FIELDS, given their focus, needed more nuanced ones. These issues led to increasing the difficulty of matching entries in ESCO with what was proposed in the profiles. Competence level: partners shared that the ESCO database does not offer different levels of a given competence. In the case of I-RESTART, which aims at building profiles for level 4, 5 and 6 of the EQF, it would be helpful if there would be descriptions of what can be achieved at each level. Skills vs knowledge concept: one of the problems when determining the skills was the labelling. In this case ESCO helped matching appropriate verbs to the skills proposed. Relationships**:** there were gaps between the relationships presented in the database and what happens in reality. For example, systems thinking is only mentioned to be related to software concepts and linked to ICT occupational profiles when in reality it is a key transversal competence, also found as one of the sustainability competences in GreenComp.

Another aspect reflected jointly with partners was regarding the experience with ESCO and other EU tools and frameworks. As mentioned previously, there is an overall awareness of EU frameworks and tools though not necessarily familiarity in terms of everyday work. Among the advantages of (using) ESCO, partners identified: ESCO could be a useful tool for training design; benchmarking learning standards, skills and competences; facilitation of data exchange on labour demand, labour supply and human capital development. In this way, ESCO is effectively seen as a useful tool to integrate the European labour market and bridge the communication gap between labour market and education and training sectors.

Among the limitations of ESCO, partners highlighted that the database presents a bit of a rigid structure and gaps in skills and knowledge concepts. Similarly, it is considered not as detailed as partners would have expected (e.g. competence levels). There is still room for improvement in terms of user friendliness: there are difficulties to obtain clear detailed information (e.g. too many steps to find the right category), bugs in navigation friendliness

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[1] A more in-depth description of the linkages between FIELDS occupational profiles and ESCO can be found in the report: Linking FIELDS occupational profiles with ESCO skills and knowledge concepts (July 2022).

and occasional lack of results produced when using the search function.

The consortium also highlighted the importance of the regular updates of the database and remaining open to a constant input of new suggestions by maintaining a constant dialogue between education and training providers and labour market actors to ensure a systematic provision of data on job openings and other opportunities. An important aspect for ESCO has to be the work on matching people to employment opportunities across borders. This requires exchanging information on qualifications, occupational experiences and skills obtained in other countries. In this way, making ESCO fully applicable and relevant in any Member State.

Some partners considered that they are perhaps too small to remain regularly involved in the work of ESCO but they see the participation in EU funded projects as a way to continue this work. There was agreement that working as part of this type of consortium is a key opportunity for partners in providing inputs related to new knowledge concepts, skills and job profiles in their sectors.

8.1.   Feedback on new skills and new knowledge concepts

In the tables below, the different skills and knowledge concepts which were included in the profiles from FIELDS task 2.1 are presented. The tables are limited to the skills and knowledge concepts which either no exact match was found in ESCO or partners provided feedback to the ESCO entries that were found. The table shows on the left in which occupational profiles (according to the order from Table 1) is the skill or knowledge concept included. It can be seen that various skills and knowledge concepts were considered either essential or optional in different profiles. In some cases, in the profiles from task 2.1 the same terms are mentioned as either skill or knowledge concepts in different profiles. With partners, a decision was made to determine the most appropriate classification.

In the middle, feedback is provided regarding the label: whether no direct match was found, if the label needs a modification or to add an alternative label as well as suggestions for new labels in case the skill or knowledge concept is not yet included in ESCO. On the right, partners in the consortium provided feedback to the descriptions found in ESCO and in the case of new additions, the potential description of the new skill or knowledge concepts. In some cases, the feedback was limited to the labels.

8.2.   Essential skills and competences

Table 9 Feedback on essential skills and competences by profile

FEEDBACK ON LABEL	FEEDBACK ON DESCRIPTION
● Labels in profiles from 2.1 show traceability, quality signs, labels, etc. Some partners took the knowledge *traceability in food industry* (from ESCO) and adapted it to their own fields: i.e. Traceability in agriculture and veterinary. Since in some cases it was mentioned in the section of essential skills and competences some partners suggested "implement traceability in…	● Proposal for skill in traceability: "Implement traceability systems in respect of different agriculture and food industry resources". Another proposal: "put in place traceability measures to respond to potential risks that can arise in food and feed, so as to ensure that all food products are safe for humans to eat". ● Partners highlighted that more specifically, learners need to get the skills to verify the history, location, or

(agriculture and veterinary, food industry)" as an alternative. ● In some cases, it was also mentioned Traceability in agricultural products.	application of an item by means of documented recorded identification. ● Partners also underlined that for these profiles learners have to know at "awareness" level, the traceability of a product in the whole food chain, but in more detail only the part that includes the agricultural practices, that is, from the production of the raw material to its delivery (it can be direct to consumer, or to a food processor or food retailer)
● Proactive thinking. ESCO matching found: think proactively.	● Partner feedback highlighted that being proactive is also an attitude rather than a thinking.
● Flexible. ESCO matching found: adapt to change	● Partner feedback highlighted that the description is limited. One can also be flexible towards external factors.
● Continuous learning. ESCO matching found: demonstrate willingness to learn.	● Partners feedback underlined that in this case, it's more than being positive about LLL (as indicated in the description) but actually implementing it. This description could be improved.
● Food chain cooperation. It had to be adapted to better represent a skill, some suggestions included: "cooperate with professionals and workers in an industry or productive sector" or more specific "cooperate with professionals and workers in the agriculture, food industry and veterinary sector". ● Some partners explained this new skill better as a knowledge concept. Some proposals included: "food chain cooperation" or "(cross-) sectoral cooperation or collaboration".	● Partner's feedback in terms of skill underlined that this term covered to use/create tools to optimise/improve cooperation among the involved actors. ● Partner's feedback in terms of knowledge concept underlined that this term included to know how the agri-food chain works and all the involved stakeholders: farmers, cooperatives, food industry, retailers, consumers...and any other less involved actors (advisors, service suppliers, policy makers, machinery providers...). ● Other partners suggested that it was not necessary to have something this specific and that the skill of working with others plus of the knowledge of the sector would be part of it.
● "Sourcing of raw materials and agricultural products" and "Sourcing of sustainable agricultural products". Found first as a skill and also as knowledge. ● Label proposal on the side of skills: Use sustainable feed sources. ● Label proposal on the side of knowledge: Sustainable feed sources and animal nutrition. Sustainable origin of raw material (sustainable sourcing).	● Proposal on the side of skill description: use animal feed and nutrition products generated in a sustainable manner. ● Proposal on the side of knowledge concept description: "Full range of available and suitable sustainable agricultural products for the food industry and where to source them"

● A related knowledge found was: "agricultural raw materials, seeds and animal feed products". This knowledge does not refer to sourcing.	
● Innovation management and its deployment. ESCO matching found: seek innovation in current practices.	● Partner's feedback included: "seek" doesn't mean "apply" it. The description looks ok. It is more how it is formulated as a competence.
● "Management of natural resources". This was expressed as knowledge therefore partners proposed the label for this skill: "manage natural resources". ESCO related skill found was: "conserve natural resources". This skill includes water and natural resources.	
● "Biomass production and transformation". Label proposal for skill: "perform biomass production and transformation". ● ESCO related entries: There is a skill called "cultivate crops for biomass". There is a knowledge called "biomass conversion". Clarification is needed in terms of what skill should the learners have in relation to this knowledge. Or whether this skill is linked to a different knowledge concept. Some partners used biomass conversion in knowledge sections.	
● "By-products and co-products valorisation", "manage plans for the utilisation of organic by-products" ● This skill proposal was also added as a related knowledge proposal: "Side stream valorisation" and "valorisation of raw materials, by-products and waste".	● Proposed description of valorisation as a skill by partners: "fosters and arranges the valorisation and use of the main co- and by-products in agricultures and the food chain". Another proposal is: "performs valorisation of by-products from agro-industries". ● The proposed description for "manage plans for the utilisation of organic by-products" is "implement plans for the utilisation of organic by-products. Ensure that plans for the utilisation of organic by-products are in accordance with relevant legislation, codes of practice and cropping policies. Ensure that systems are in place to protect humans and animals from the dangers of working with organic by-products such as slurry gases. Monitor the utilisation of organic by-products and take appropriate action if problems are identified".

● soil health management. The ESCO matching found was ensure soil fertility. A related skill found was maintain plant soil nutrition. However the mention of gardening in the description was not fitting for some partners. ● Proposed alternative label was: manage soil fertility.	● Feedback from partners underline: ensure soil fertility should cover the biological and mineral. ● On the related skill: "maintain plant soil nutrition", partners underlined that instead of mentioning gardening for FIELDS what is relevant covers the following: "implements measures to maintain and/or improve the nutrient density (fertility) of soil"
● Crop rotation and new crop techniques. Partners suggested the label suggestion: "manage crop rotation".	● Description suggestion from partners: "Plan and perform crop rotation and other crop management techniques".
● Water/groundwater management. After consultation partners suggested a more fitting label: "manage on-farm water". Another label suggestion by partners was: "water treatment and reuse" ● Some partners have used ESCO's "perform water treatments" linked to this skill and also "conserve water resource". ● Partners suggested that "watershed development" is also closely linked to this skill.	● Description suggestion by partners on "manage on-farm water": Performs all aspects related to water management (rainfall, irrigation, etc.), from its origin to making it available to the crop through irrigation (how much and when to irrigate).
● From task 2.1 profile: Adaptation and mitigation to climate change. Partner's label suggestion: "perform climate smart agriculture" or "adapts to and mitigates climate change effects". This skill can be linked to this knowledge in ESCO: "climate smart agriculture".	● Description suggestions from partners include: Adapt to and mitigate the effects of climate change at farm management level. It covers water, energy, fertilisation, etc. management on farms to adapt to and mitigate the effects of climate change. ● The description of the knowledge concept in ESCO for "climate smart agriculture" mentions adapt, it could also include mitigate.
● Low emission spreading/spraying equipment and practices. The label suggestion from partners was: "use phytosanitary equipment".	● Description suggestion by partners: Uses phytosanitary treatment equipment correctly taking into account spray droplet size, care with wind drift so as not to affect other crops or natural vegetation, etc.
● Energy management: energy efficiency and renewable energy. Label suggestion from partners: "manage energy resources".	● Description suggestion from partners: use energy efficiently and promote the use of renewable energies (mainly the photovoltaic).

8.3.   Essential knowledge

Table 10 Feedback on essential knowledge concepts by profile

● Introduction to machinery with digitalisation tools. A related ESCO knowledge concept found: agricultural equipment. Suggestion label from partners on Digitalisation profiles an option could be: "agricultural digital equipment".	● Partners proposed an amendment to the description of agricultural equipment. "The offered agriculture machines, equipment products and DIGITAL TOOLS. Their functionalities, properties and legal and regulatory requirements".
● sustainability. Partners suggested a link to GreenComp could be made. In ESCO transversal skills, we can find "applying environmental skills and competences" and more specifically "engage others in environment friendly behaviours". Some partners have included this rather as a skill: "promote sustainability". ● There were also suggestions on whether more specific knowledge concepts could be created, i.e. "sustainability in agriculture", "sustainability in the food industry" "sustainability in veterinary".	● Partners highlighted that sustainability knowledge should include among others: food ethics, water reuse, side stream valorisation (from food industry, from farm) and co-products. ● Another suggestion was to include knowledge on sustainable development goals and/or making links to the EU GreenComp. ● For veterinary it would cover "Application of sustainable practices in veterinary".
● Cooperatives. Label suggestion from partners: comment: "agricultural cooperatives". ● Partners highlighted that cooperatives are an important legal form in several EU countries, some years ago it was the internationally celebrated year of cooperatives. It is not ideal to have this knowledge gap in the ESCO database.	● Partners suggested using the definition agreed by the International Cooperative Alliance: A cooperative (also known as co-operative, co-op, or coop) is "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned enterprise".
● Knowledge of agri-food communities. Label was not matched in ESCO. This knowledge like the food industry one can be implied in the skill regarding food chain cooperation.	
● Interdisciplinary knowledge. There was no clear match in ESCO. "Systems thinking" was considered an alternative.	● Partners feedback include making a linkage to the sustainability competences: GreenComp. ● The knowledge concept in ESCO "systems thinking" is narrowly connected in the relationship section to the technological sector which is far from reality.
● "Circular manufacturing / Industry 4.0". There was no specific match in ESCO.	● Partners suggested the following description: Innovative circular manufacturing technologies enhanced with novel production mechanisms and digitalization aspects promoting energy efficient and low material consumption production processes, resulting in reduced greenhouse gas emissions and air pollutants.
● Knowledge of Management Information Systems. In ESCO a skill was found on "use agricultural information systems and databases". ● A potential label for a knowledge concept would be: "agricultural management information systems".	● A proposed description based on the skill mentioned on the left column: "management information systems and databases to plan, manage and operate agricultural enterprise and production".

● Knowledge about the agrifood production chain. A general knowledge on "supply chain principles" was found in ESCO. This could be added to this profile and the curricula design would specify the content on specific sectors supply chains.	● A more specific description would have to be developed if specific knowledge concepts labels of agriculture or food supply/production chain and supply/production chain are created.
● ecosystem services. In ESCO a general knowledge on ecosystems was found. ● It was considered that a specific knowledge on ecosystem services is required. However, it was also recognised that this knowledge might already be touched upon indirectly in other knowledge concepts which are part of the occupational profiles developed.	● A proposed description for ecosystem services would be: "Knowledge about ecosystem services, meaning the varied benefits to humans provided by healthy ecosystems, and in specific ecosystems. Consisting of all plants, animals, and micro-organisms (biotic) functioning together with all of the non-living physical (abiotic) factors of the environment" (One-Health approach). ● Another description proposed was: "Understanding the benefits both direct and indirect that humans obtain from the environment".
● knowledge concepts on nutrients for example: nutrients circulation vs nutrients removal, soil nutrients as well as development of new proteins and new protein fractions. No direct knowledge was found in ESCO. ● A related skill was found in ESCO: manage nutrients. Another skill related to nutrients is ensure soil fertility. The knowledge found in ESCO around nutrients was on nutrition under the health classification.	
● emerging technologies. Matched found in ESCO: emergent technologies. Partners from the food industry suggested that maybe a specific knowledge on "emergent technologies in the food industry" could be added.	
● Manufacturing technologies. No exact match in ESCO, there were various manufacturing technologies covering specific sectors.	● Partners commented that this knowledge is about the main food transformation sectors, providing representative examples of each food processing subsector, describing the related unit operations. They also warned that this is a huge area of knowledge.
● biodiversity. There was no exact match in ESCO. Partners mentioned that this could be put together with ecosystem service as a knowledge of "biodiversity and Ecosystem services".	
● Prevention and management of natural disturbances. In ESCO, a linked knowledge found is "protection from natural elements".	● Partners provided suggestions to modify this knowledge description in ESCO: "Forces of nature, such as weather patterns and seasonal conditions, their characteristics as well as their consequences (incl. e.g extensive insect outbreaks) and any means of protection against them". ● Another feedback suggested: "Forces of nature, such as weather patterns and seasonal conditions, their characteristics and any means of mitigating them". This includes: "vulnerability assessment, resilience analysis, risk management and adaptation strategies within linked human–environment

	systems, and environmentally induced internal displacement and transboundary migration."
● Environmental management aspects. No specific match in knowledge was found in ESCO. There were some related skills found: manage environmental management system and monitor the farm environmental management plan. ● Partners suggested that "environmental management principles" could be a new umbrella knowledge that might include other knowledge concepts mentioned in the profiles such as: climate change, emission reduction, among others, etc.	
● good agricultural practices. Partners suggested modifying this into Good agricultural practices at farm level which could encompass crop diversification, conservation farming, agri-food, biodiversity, crop protection, grassland management, among others, etc.	● This is a very general concept that would group together "good agricultural practices to minimise environmental impact"

8.4. Optional skills and competences

Table 11 Feedback on optional skills and competences by profile

● it was found with different names such as use of LCA tools and LCA aspects. Suggestion: Use of life cycle assessment tools in agriculture. ● There is a skill in ESCO: assess the life cycle of resources. This could encompass the skill to use LCA tools, however this aspect is not included in the description.	● Suggestion: Use ICT tools available for life cycle assessment of products, processes and services in agriculture. Another option could be "product life-cycle" as both (resources and products) can be included when somebody understands life cycle aspects.
● use of robots and drones. Skill found in ESCO: make use of personal robots for practical support ● Feedback from partners underlined that if used in a professional environment the term 'personal' robot might be misleading. Similarly, perhaps a skill focused on use of robots in agriculture might be useful to have.	
● Digital entrepreneurship. It was added as knowledge in some cases. There was no exact match in ESCO.	● Entrepreneurship competence from EU EntreComp: when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social. ● Perhaps in the description it could be added the precision on the digital sphere or using digital tools. It could also be a skill that combines the entrepreneurship and using digital tools skills.

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● Application of circular economy and recycling practices. The knowledge on circular economy is already included in all profiles. It was suggested that applying circular economy principles could be considered also a skill.	
● wood processing. manipulate wood was suggested as the closest fit. Another label proposed was: "wood processing and energy production".	● Suggestion for description: "Transforming the properties, shape and size of wood".

8.5.   Optional knowledge

Table 5: Feedback on optional knowledge concepts by profile

● Sustainable packaging. No exact match was found in ESCO. There is general knowledge on packaging processes in ESCO, perhaps it could be adapted or add new knowledge on "sustainable packaging processes".	● Suggestion to modify from partners: "(Sustainable) packaging design and development. Decorating and printing processes executed in packaging. Packaging machinery and line operations".

9. Cedefop

Cedefop has also touched upon the topic of ensuring quality certification in VET. In a study from 2015 Cedefop identified eight key quality features which guarantee that the certification processes are consistent across a VET system. It was underlined that to strengthen trust in certification, it is essential for learners to be assessed against a set of clear reference points expressed in terms of learning outcomes. It is also important that certification results are comparable across the VET system within a particular institution or at country level. In this process, the representatives of the world of work have a bridging role between VET and the labour market.

The key features of certification are: i) addressing certification in formal quality assurance mechanisms, ii) providing clear reference points for assessment, iii) providing information to stakeholders, iv) selection requirements and training of assessors, v) quality of assessment methods and procedures, vi) verification quality and grading, vii) appeal procedures and viii) documentation, evaluation and monitoring of certification. The study also makes a link with the EQAVET framework, proposing descriptors and indicators for each phase of the quality cycle in VET (planning, implementation, evaluation and review. Some of the EQAVET indicators might not directly relate to the main certification elements but they could be seen as relevant in terms of certification results such as: i) indicator 4 completion rate in VET programmes; ii) indicator 5, placement rate of VET graduates; iii) indicator 6, utilisation of acquired skills at the workplace and iv) indicator 9, mechanisms to identify training needs in the labour market.

BOX 01: Cedefop and learning outcomes in VET

Last June, Cedefop organised a *forum around learning outcomes in VET* with a focus on the new publication "European Handbook on learning outcomes"(Cedefop 2022a). It was highlighted that learning outcomes operating at the interface of VET, supply and demand side, and articulating how the demands of the labour market can be translated into national VET programmes and curricula, stand out as a key instrument for

coordinating and governing VET. Below, relevant literature for FIELDS partners working on current and upcoming work packages is presented:

- *European Handbook on learning outcomes:* provides practical guidance based on mutual learning and systematic research on defining, writing and applying learning outcomes.

- *Review and Renewal of Qualifications:* This research paper forms part of CEDEFOP's *Comparing VET qualifications project*, which seeks to develop robust and scalable methods for analysing and comparing the content and profile of qualifications. Focusing on the dialogue (feedback loop) between VET and labour market stakeholders, the paper analyses existing methodologies in this area and outlines how to develop these further.

- *Comparing vocational education and training qualifications*: This report brings together the findings of the CEDEFOP project Comparing vocational education and training qualifications: towards a European comparative methodology. Looking into the challenges related to the in-depth analysis and comparison of the content of VET qualifications, the report provides a methodological basis on which both researchers and policy-makers can build.

- *The Future of VET - The changing content and profile of VET:* This study examines changes in the way that knowledge, skills and competence are differentiated in curricula, and how learning is organised across different learning sites: in classrooms, workshops or laboratories, and at workplaces. The study collected information through Cedefop's ReferNet network, in-depth country case studies, and an online survey among almost 1 000 European VET providers.

9.1.   Microcredentials

Microcredentials have an important role to play in upskilling and reskilling, quickly and accurately responding to the needs of the labour market, providing more flexible learning pathways, providing ways to recognize prior learning, and making knowledge, skills and competences more visible. Microcredentials are sought by learners with diverse range of characteristics but, due to the main purposes of microcredentials being closely linked to labour market relevance and flexibility, they are largely used by adults. Parts of qualifications or modules are often considered to be equivalent to microcredentials in some VET systems.

The main purposes and objectives of microcredentials echo the goals of modularised learning, which helps explain why many stakeholders identify microcredentials as partial or module certificates. However, there are also opposing opinions, explaining that microcredentials should not only be identified as deconstructed qualifications, but should also refer to something supplementary to the existing system. Despite these diverging opinions, microcredentials are largely seen as not posing any major threats in terms of replacing or substituting for formal qualifications because they serve different purposes and target different markets.

9.2.   Effects of the Covid-19 on European labour markets

According to the European Commission's spring 2020 economic prediction (EC, 2020), the coronavirus outbreak will likely have a severe impact on EU jobs and skills and cause the unemployment rate to increase from 7.5% in 2019 to 9.5% in 2020.

Cedefop's Cov19R index (Pouliakas, 2020) reveals that employees in occupations that depend a lot on physical closeness and interpersonal skills may experience greater productivity losses and disrupted business operations. Although the Cedefop analysis of the risk of automation in EU labour markets (Pouliakas, 2018) warns that many

such jobs, which are dependent on interpersonal communication and have limited exposure to digital technologies, cannot be fully replaced by machines and artificial intelligence processes, employers in more vulnerable sectors may be tempted to speed up the process of automation anticipated before Covid-19.

9.2.1. Learning from one another

Despite the fact that the current economic crisis is unprecedented, there are many instances of policy programs and initiatives that have been undertaken in Member States that can serve as an inspiration at this time. In response to the difficulty of assisting the (long-term) unemployed in finding employment, Member States implemented a number of creative initiatives as early as 2018, according to the Cedefop study (Cedefop, 2018). A lot of these tailored up- and reskilling programs are accessible through Cedefop's online Matching skills tool. The tool is intended for decision-makers who work in the fields of skills, skills development, (active) labour market policy, and associated policy areas. It provides policymakers developing training programs in the coronavirus era with several motivating examples of how policy instruments from EU Member States use data on labour market changes and expected skill shortages to guide and shape upskilling or other skills matching policies.
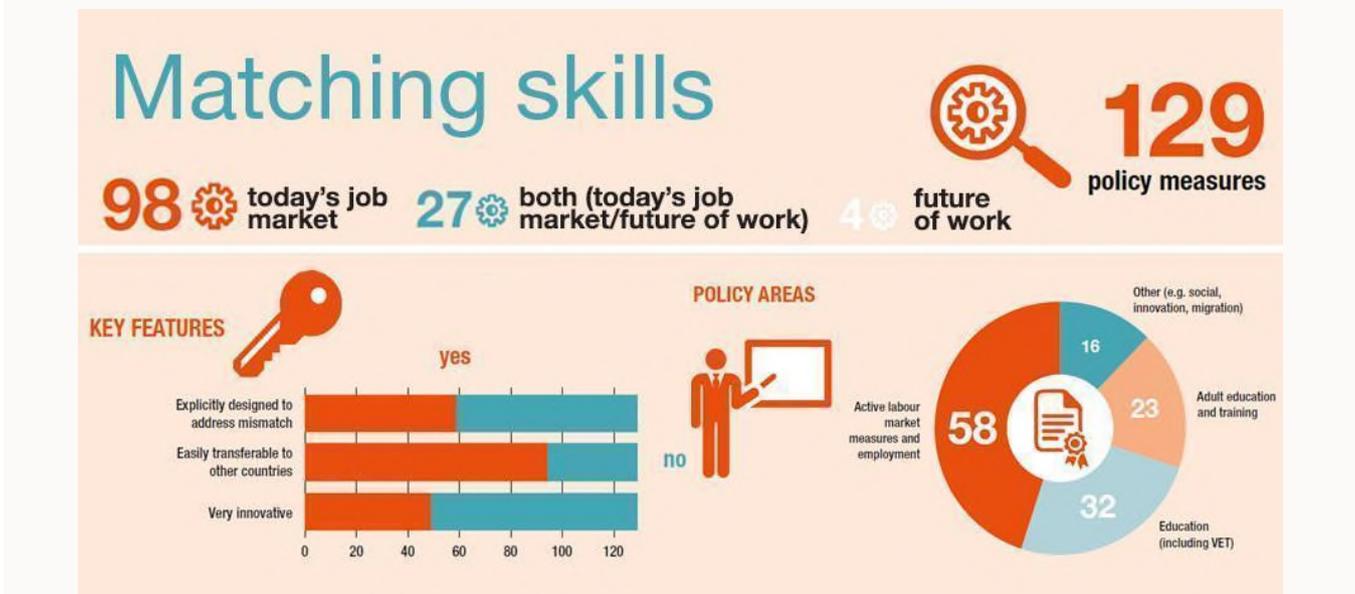

Figure 20. Cedefop's Matching skills online tool

Perhaps ahead of its time, the policy instrument 'Online courses' aimed to improve the competences and employability of workers and job seekers in Flanders, Belgium by giving them easy and free access to 635 online courses. Information on available training courses and relevant assessment/certification is one of the elements offered by the 'Education and work' portal in Czechia. The platform also supports jobseekers by raising awareness of skills needed for occupations, offering job guidance and a list of available vacancies, posted by employers.

With a significant number of formerly employed persons now in inactivity or furlough, valuable lessons may also be learnt from expanding initiatives such as the 'permanent seasonal work' scheme, which provides financial support and tailored training to seasonal workers during periods of reduced work. Vulnerable unemployed groups can also be included in programmes of involvement in socially beneficial jobs, which are typically in social care, education and environment protection and preservation – all crucial areas for societies coping with the coronavirus aftermath.

Further relevant case studies from Croatia and Denmark support the preservation of jobs due to temporary reduction of economic activities or via a win-win system of job rotation between employed and unemployed

workers (the former obtaining continuing education, the latter learning on the job).

In sectors more heavily battered by the coronavirus crisis, such as retail and tourism, some businesses – particularly SMEs – may need to cease operations permanently, highlighting a need for policy-makers to support those laid-off re-entering the labour market. Supporting the unemployed in selected sectors with training, internship placements, as well as provision of counselling services and certification can be realised through a training voucher programme, as in the case of Greece.

To soften the blow of the crisis on youth unemployment, the Dutch school extension programme is a good example. It was built around the notion that in times of economic difficulty, it can be more advantageous for graduates (or leavers) of secondary VET to keep on studying and learning.

Overall, designing comprehensive programmes based on careful diagnostic sessions, monitoring of the laid-off population, customised sectoral training and collaboration with sectoral professionals – such as Luxembourg's Fit4Jobs schemes – may ensure that both labour market and individual jobseeker requirements are met during the skills matching process; at the same time it may also be opportune for local community policy-makers to develop work-based learning and apprenticeship programmes aimed at aiding local business development and skill development tailored to local skill needs.

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