Innovation and Capacity building

in Agricultural Environmental and Rural UAV Services

ICAERUS

D4.1: Syllabus and Certification Criteria

WP4: Capacity Building and Value-Added Services

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Executive Summary

This report is part of Work Package 4 (WP4) of the *Innovation and Capacity building in Agricultural Environmental and Rural UAV Services* (ICAERUS) project. WP4 aims to build capacity in the sector, broadly defined as the use of UAVs (drones) in rural areas for activities linked to agriculture, forestry, livestock management and other environmental or rural services, such as delivery, and as specified in the Use Cases of the project.

This deliverable focuses on capacity building, which is defined within this context as developing and enhancing skills, knowledge and understanding of stakeholders linked to the above Use Cases. This is operationalised by the design of an online, open access module created for a diverse set of stakeholders. The ultimate purpose is to empower individual stakeholders, and their partnerships and coalitions, to develop further the (entrepreneurial) ecosystems that will support the use of UAVs for agricultural, forestry and rural services.

Focus groups were organised with stakeholders from each of the Use Cases to identify the existing levels of knowledge and understanding of the use of UAVs and to explore the barriers and challenges, knowledge gaps and requirements to further develop (entrepreneurial) ecosystems. The Use Case-specific focus groups were complemented by a learning design workshop, which created a way to further discuss and clarify a syllabus to address the identified knowledge and skills gaps. The focus groups collected empirical data from stakeholders 'in the field', which was added to the market and industry analyses of ICAERUS WP1. These were supplemented by desk research on available open access learning courses on the use of drones.

The focus groups collectively brought together diverse stakeholders, ranging from farmers, government bodies, agronomists, software engineers and drone service companies. A set of pre-agreed questions was used to initiate discussions and to explore with the groups the areas related to capacity building, education and training. The themes of the questions addressed were: 1) barriers and challenges faced by stakeholders and how these could be overcome, 2) business-related knowledge, necessary to establish new businesses in the sector, to upgrade existing business skills and to identify business opportunities, and 3) partnerships and coalitions that would enhance the adoption of UAVs in agriculture, forestry and rural areas.

Translations of focus group verbatim transcriptions were analysed with 'thematic analysis' to identify common themes across the Use Cases and areas of investigation. The process of analysis is a well-established and thorough research method that revealed four broad themes in the data for developing education and training:

1. Knowledge of drone equipment and data
2. Drone operation knowledge and skills
3. Business-related skills: Business models
4. Business-related skills: General business skills

The outcomes of the focus groups were discussed during a learning design workshop with ICAERUS members and other stakeholders, such as academics in entrepreneurship, experts in learning and teaching design and specialists in online and self-directed learning. In addition, the WP4 team reviewed the outcomes of WP1's landscape analysis and of the desk research on available online courses, generated by searching for 'business', 'drones' and 'course'. This comprehensive and thorough approach revealed several implications for training and business development, consistent across the different Use Case contexts. The complexity of needs across the constituent parts of the ecosystems, required for further ecosystem development, was acknowledged.

The learning design workshop informed the learning outcomes for the course and the content of a syllabus that will meet the needs of prospective stakeholders with an interest in developing new businesses on using UAVs for agriculture, forestry and rural services. The syllabus also aligns with the ICAERUS Open Calls and with WP5 to support new business ideas and entrepreneurs to validate their value propositions, as well as to identify the range of services they can offer and the impact they can expect to make. This

also achieves the dual purpose of offering appropriate knowledge and support to ensure value for money for the financial investments in those businesses.

The open access online module will support learners to meet five learning outcomes, which involve developing **knowledge and understanding** of the drone industry, the emerging innovations in the sector and the different business models for commercialising the use of drones. This knowledge is complemented by content, activities and demonstrations that will assist learners to first, develop **cognitive skills** to collect and analyse relevant information to develop a new business idea, and second, to develop **practical and professional skills** to evaluate business sustainability and to articulate and communicate business ideas to different stakeholders.

The syllabus is comprised of 8 weeks, with learners that engage fully and take the self-directed assessment to gain a Badge for a CPD (Continuing Professional Development) Accredited Course. The weeks of the syllabus will cover the following:

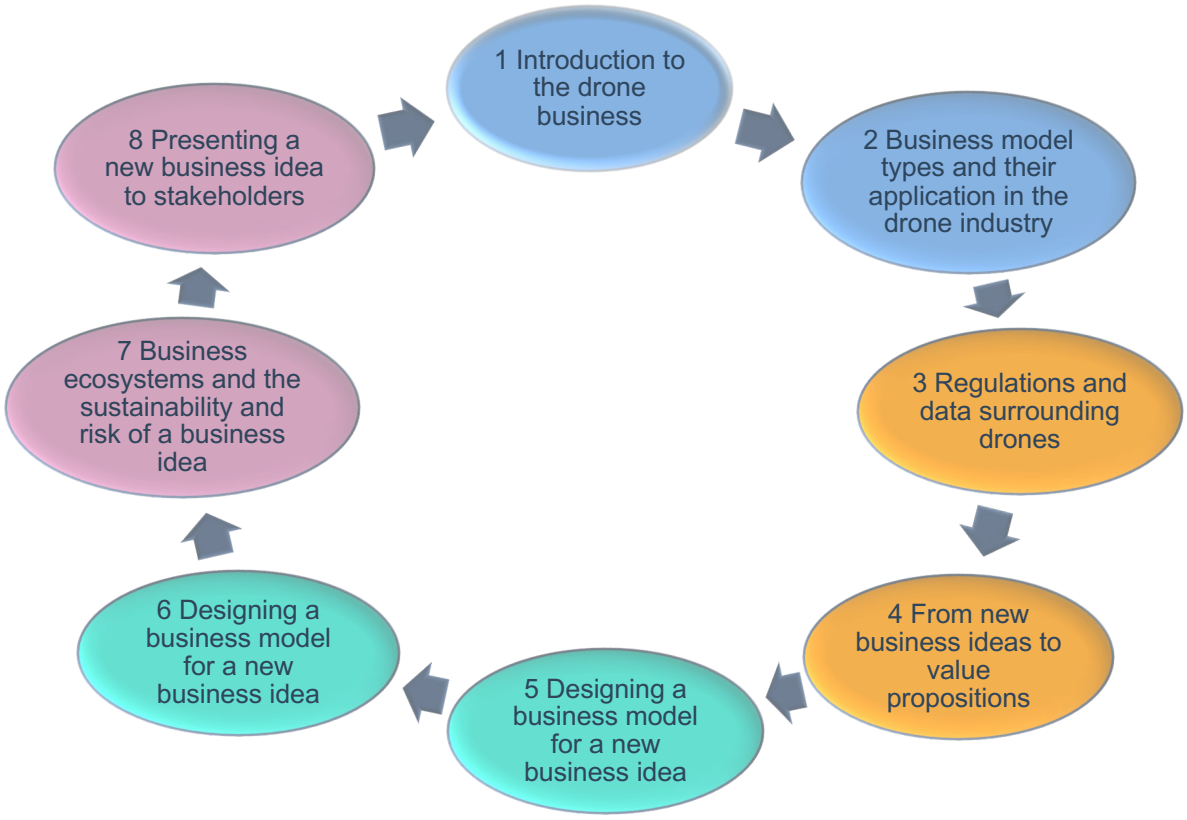

Figure 1. Indicative syllabus topics for an 8-week online course

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1. Introduction

A key objective of the ICAERUS project is to strengthen the capacities and develop skills of regional and local ecosystems through free, open-access education, training and value-added services to apply drones to agricultural, forestry and rural sectors. Five Use Cases provide opportunities to demonstrate multiple ways in which drones can be applied to crop and livestock monitoring, spraying, forestry and biodiversity, and rural logistics. The Use Cases are situated in five countries (see Figure 2).

Figure 2: Use cases of the ICAERUS project

The Use Cases represent robust civil society partnerships that harness local knowledge and skills and build on network relationships to create synergies and links with local stakeholders. The project further supports technological innovations through open call trials to identify potential business models to scale up and maximise the impact of the innovations.

1.1 ICAERUS education and training

The ICAERUS Academy will form a central hub for education and training for stakeholders across the regional and European ecosystem. A key component of the education and training programme is a 24-hour free, open-access online course that builds the capacities of local stakeholders to apply technological innovations in their local contexts. An important focus of the course is to support stakeholder development of business models, for example as part of applications to the open calls, with the Use Cases providing examples of not just the technological innovations but also examples of the issues stakeholders will need to consider in order to create a viable value proposition. A value proposition communicates to potential stakeholders and/or customers how a product or service will solve or address a specific need. The course aims to help potential service providers and end-users to effectively identify their needs and to clearly articulate how their drone-based service or product will address needs within the agricultural, forestry or rural sectors.

This report presents the first stage of course development with an indicative course syllabus and identification of potential certification criteria. The report explains the participatory learning design methods by which the syllabus has been developed, namely via a series of focus groups that were conducted in the local Use Case contexts and which built on the landscape analysis of the ICAREUS project's Work Package 1. It also details the learning design process undertaken through a 'learning design workshop' and the development of 'personas', i.e., example learners for whom the course is designed and targets.

1.2 A free, open access course for ICAERUS capacity building

The course will be featured on *OpenLearn*, the free and open access online platform of the Open University in the United Kingdom. Launched in 2006, OpenLearn has been accessed by over 100 million users across the world to learn from more than 1,000 free and open access courses covering a wide range of topics

from the Open University's formal curriculum, as well as covering culturally popular topics and subjects relating to current affairs.

The course will consist of eight weeks of online learning (3 hours per week) with two online quizzes – one at the end of week 4 and one at the end of week 8 – to provide the basis for certification. Each week will utilise an innovative cycle of learning that will provide learners with knowledge and skills, real world examples from the ICAERUS project and opportunities to apply their learning with concrete and relevant outputs. The first week (3 hours) of learning material is planned to be made available in early January 2024 with the text of the full course available via the platform by June 2024. The course will be launched in English, but it is expected that it will be translated into other languages to increase its accessibility to stakeholders across the European region as a primary resource of the ICAERUS Academy.

1.3 Structure of the Report

This report is divided into five sections. **(1) Methodology** details the learning design process undertaken, including seven focus groups bringing together a broad range of stakeholders within each of the Use Case contexts and a learning design workshop held with Use Case partners and other stakeholders. **(2) Findings from the focus groups** provides an analysis of the focus group data to identify common learning needs of stakeholders across the different groups. **(3) Discussion and implications for learning** summarises the learning needs identified and links these to WP1's landscape analysis. This section also presents a brief review of existing online courses related to drones and business creation and discusses how the course can address different stakeholders' levels of understanding. **(4) Syllabus and learning needs** presents the indicative syllabus, including proposed learning outcomes, an explanation of the course learning model and structure and indicative content and its assessment strategy. **(5) Conclusions** summarises the key findings for this part of the ICAERUS project and offers implications and next steps.

2. Methodology

2.1 Research methods

The syllabus is informed by four phases of data collection and analysis. Each phase provided important information on the learning needs of stakeholders across the drone ecosystem and contributed to an iterative process of refinement of the topic areas to cover. Figure 3 illustrates the four phases of the design process.

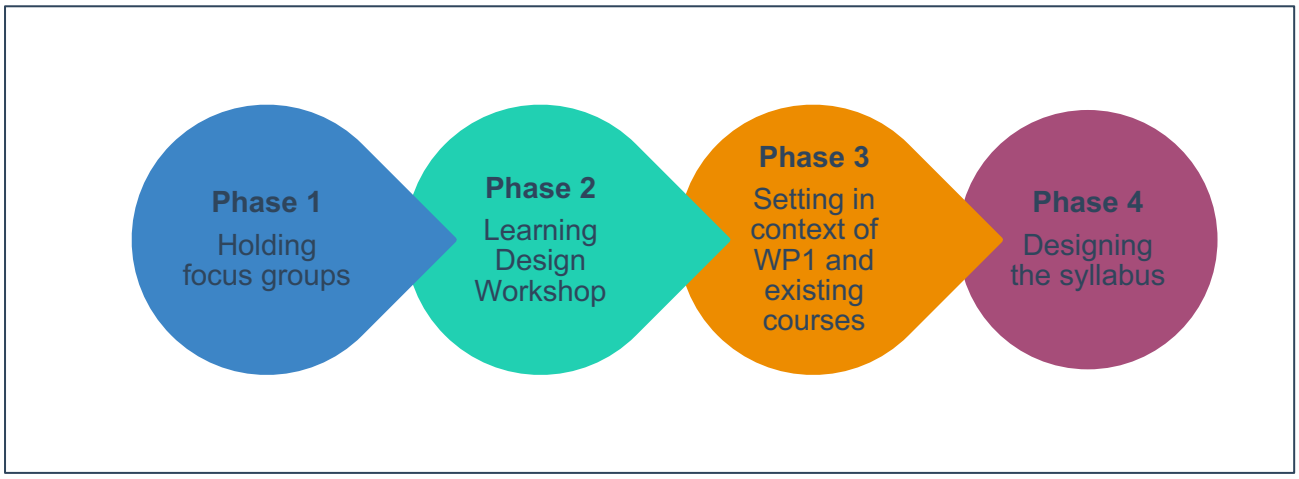

Figure 3: Methodology for creating the design of the syllabus

1. In **Phase 1**, seven focus groups were held, with focus group questions drawing on the findings of ICAERUS Work Package 1 – Task 1.1, *European Landscape of Drone Innovations and Technologies*. Each Use Case partner facilitated a focus group discussion with representatives of their local stakeholder network, and an additional two focus group sessions were held with other relevant, European stakeholders.
2. In **Phase 2**, a Learning Design Workshop was facilitated by members of the UK ICAERUS team. This was a hybrid workshop to allow non-UK members of the ICAERUS Project and Use Cases to contribute to the discussion and design of the syllabus.
3. In **Phase 3**, a final collection of information analyses sets the results of the focus groups in the context the findings of Work Package 1 – Task 1.1 *European Landscape of Drone Innovations and Technologies*, as well as a review of existing online courses on the business uses of drones and a review of recent pedagogical approaches for teaching entrepreneurship and business venturing topics.
4. **Phase 4** represents the design and drafting of the syllabus, which can be found in Section 4 of this report.

2.2 Phase 1: Focus groups

The focus group approach adopted in Phase 1 was informed by a set of surveys, expert interviews and market analyses conducted for WP 1, which examined the individual perspectives of different stakeholders in the UAV domain. The WP1 survey asked stakeholders to rank the importance of different areas of the domain regarding knowledge, technology development, communication, market access, collaborative activities, shared values, partnerships and funding/financing, training, policy and governance and other matters related to capacity-building within the domain. In WPI, the survey data were used to perform a stakeholder analysis that mapped the importance of roles, value exchanges and value-adding transactions across the domain's stakeholders. These stakeholder analyses were joined with a set of market analyses examining the markets and ecosystems of the regions of the five Use Cases to create a comprehensive landscape analysis of the UAV ecosystem.

The ICAERUS focus groups built on the preliminary survey results by focusing on how the different stakeholders' views interact, intersect and diverge within the local UAV domains in each of the Use Case countries with the aim to develop an in depth understanding of stakeholder learning needs. Focus groups are a useful way to explore in greater depth 'trends, variances, reasons and causes, attitudes and opinions' of group members (Sarantakos, 2012, p. 207) and help to reveal synergies and differences (Morgan, 1997).

An important facet of this stage of the ICAERUS project was to identify mechanisms for shared and collaborative capacity-building within the use case environments and to help to identify which stakeholders would benefit most from the course and their key learning needs. Focus groups can assist in identifying areas for capacity-building and are a well-known method for informing the design and development of learning modules (especially those offered online) through user-centred design processes (Schmidt et al., 2020). Data from focus groups or other methods are often used to develop learning 'personas', which aim to provide example representative learners for the proposed course.

In this sense there are several layers of contextualisation that influence the composition of the focus groups (Gomm, 2008) and the participants' representativeness, i.e., stakeholder group perspective, national context, use case context. Focus groups can also help to understand experiences of cultural groups (Hughes & DuMont, 2002), and facilitate the development and understanding of social narratives and social communication (Hollander, 2004). Focus groups were considered an ideal method for understanding the learning needs of a diverse set of stakeholders across the different Use Case contexts as well as a robust method to capture commonalities and differences within the local ecosystems of each Use Case.

2.2.1 The focus group protocol

As the focus groups were intended in part to identify the learning needs for building business knowledge and skills, an initial interview was held with Charles Baden-Fuller, a highly cited expert in business model research (see Prof. Baden-Fuller's *webpage* for more information). This initial interview highlighted the importance of using a holistic perspective when considering capacity building of the drone industry: the development of capacity should consider the current stage of the industry's lifecycle.

An initial protocol for the focus groups was developed indicating the broad areas for investigation, potential questions to be discussed, and stakeholder groups to be invited to participate. The initial protocol obtained ethical approval by the Open University's Human Research Ethics Committee and was subsequently piloted with a focus group in Greece with stakeholders related to Use Case 2, which is examining the use of drones in agricultural spraying. The pilot of the protocol resulted in a reduction of the number of topics covered by the focus group questions to allow for a greater depth of discussion on specific and key areas of the investigation. This revised protocol was then used in the remaining six focus groups.

The finalised focus group protocol included questions covering three main areas:

1) **Barriers or challenges**: Participants were asked to identify and discuss the challenges or barriers faced by potential stakeholders (e.g., farmers, drone users, service providers) in developing drone business ideas and accessing the market. The aim of this introductory question was to put participants at ease with the focus group and to get to know other participants. The related questions revolved around how challenges and barriers could be overcome.
2) **Business-related knowledge**: A second series of questions invited participants to reflect on the business knowledge necessary to develop business ideas using drones in agricultural, forestry and rural contexts. Sub-questions explored (1) topics to be known for developing a business, (2) target stakeholders to be engaged in the training, and (3) the initial level of understanding of potential users.

3) **Partnerships**: The final series of questions aimed to explore the possible engagement of partners in the scaling up of businesses using drone technologies. Participants were asked to reflect on what partnerships with the private or public sector could enhance adoption.

See Annex I for the project presentation given to focus groups' participants, and Annex II for the focus group protocol.

2.2.1 Focus group process

In addition to the five focus groups planned to cover the five ICAERUS Use Cases (Greece, France, Lithuania, North Macedonia and Spain), an additional focus group was held with stakeholders and related experts in Italy. A seventh focus group was held with a group representing a different set of stakeholders in the North Macedonian rural logistics sector, thus bringing the total number of focus groups to seven (see Table 1, below).

Following the finalisation of the protocol, each Use Case team translated the focus group questions and consent forms into their local language. Moderators were selected from each Use Case team, and focus groups were conducted in the local language. The focus group held in Italy was conducted in English.

Two training sessions were held for focus group moderators and Use Case partners ahead of the focus groups. A set of guidelines was distributed to each moderator, and the training sessions covered the selection of participants, the management of consent forms, the recording of the session, the handling of the data collection and the transcription process. To limit any participation challenges that might occur in holding face-to-face focus groups (e.g., a potential geographical spread of participants), moderators were briefed on conducting online or hybrid focus groups using Zoom or Microsoft Teams. Moderators were also briefed on how to deal with potential instances of 'groupthink' (Hollander, 2004), wherein some participants may agree (or disagree) with the group due to social desirability. The facilitators issued clear instructions to the group and used probing questions to assess the nuances of the participants' opinions.

The issue of coercion was also covered explicitly in the training as well as the importance of informed consent. The consent form outlined clearly the four different areas suggested by Sim (2010): (1) disclosure (the adequacy of the information given by the researcher); (2) comprehension (the extent to which this information is understood by the participant); (3) competence (the participant's cognitive or emotional capacity to give or withhold agreement); (4) voluntariness (the absence of inducement or coercion).

The focus group protocol was designed to last one hour following a brief introduction to the ICAERUS project and the specific Use Case context presented by the focus group Moderator (for the Italian focus group, an overview of the full ICAERUS project was provided). Participants were then invited to introduce themselves, and the Moderator explained the purpose of the focus group questions.

Each focus group was recorded and transcribed verbatim anonymising participants and then each Use Case team translated the transcribed data into English.

2.2.2 The selection of participants

Focus group participants were recruited for their interest and knowledge of the topics to be covered with priority given to farmers and drone experts or users in agricultural, forestry and rural settings. In identifying their potential participants, Use Case partners considered the respondents to the WP1 survey and expert interviews. Specific guidance was given in the moderator training events to support their identification of participants and how best to approach them.

Each focus group comprised of 4-9 participants to afford a diversity of perspectives to be represented while also allowing each participant to contribute to the discussion. Table 1, below, provides further detail on the focus groups held and the number and types of participants represented.

Table 1. Data collected and representative stakeholders of the focus groups

Focus group #	Location	Use Case	Number of participants	Type of participants
1	Greece	2 – Drone Spraying	9	Academic in agriculture Public-Private Partnerships (PPPs) representative Industry representatives: agricultural machinery, UAV services and products
2	Italy	All	9	Academics in law and business, Accounting, Entrepreneurship, Public Policy, Strategy Manager of Venture Capital fund Managers of a certification body
3	Spain	1 – Crop Monitoring	4	Academic in computation Academic in AI Business operator in drones Videographer specialised in 3D models
4	France	3 – Livestock monitoring	5	Data scientist Grassland and pastor project manager Coordinator of farmer network (Digifermes) studying digital solutions Agricultural engineering student Sheep farmer
5	Lithuania	4 – Forestry Biodiversity	8	Sector associations representative Drone manufacturers Drone service companies Drone software engineers Tech research and development
6	North Macedonia	5 – Rural Logistics	4	Farmers Technical engineers Government bodies Non-governmental organisations
7	Greece (North Macedonia)	5 – Rural Logistics	7	Software Engineers Surveyor Engineers Geoinformatics Engineers Geologist Agronomists Economists

As depicted in Table 1, there was a wide range of stakeholders represented in the focus groups. Heterogeneity of the focus group sample was encouraged not only to support a diversity of perspectives to be voiced but also to represent the diversity of the different local contexts of the Use Cases. The samples were purposive, that is to say, potential participants were selected based on their potential to represent a diverse set of voices from the local context with analyses to identify common learning needs discussed across the full set of focus groups. This approach allowed for the design of a training course that can have the most impact in developing business knowledge and skills for stakeholders in a variety of agricultural, forestry and rural contexts.

2.2.3 Coding

The translated interview transcripts were analysed using a thematic analysis approach 'to find repeated patterns of meaning' (Braun & Clarke, 2006, p. 86) across the focus groups as well as to identify interesting differences arising from contextual variation. A thematic analysis approach supports the distinction

between the questions posed to participants and the questions guiding the coding (Braun & Clarke, 2006), where themes can emerge from the data to answer the research question even if the participants are not explicitly answering that question (i.e., a participant could be answering a question about challenges in entering the drone market, but their answer relates to training needs). It is also important to note that the heterogeneity of the participant groups also supported this type of inductive analysis as the anonymisation of the data meant that it was impossible to *consistently* attribute specific learning needs to any one stakeholder speaking (such as a farmer).

Following the iterative data analysis method discussed by Braun & Clarke (2006), the three UK team members each did an initial read through the transcribed transcripts and then discussed their initial and early thoughts about the data. This was followed by the second step: a first round of coding that found five broad themes in the data. The third and fourth steps comprised a more detailed review of the data, which includes identifying the data (e.g., quotes) that support each of the themes and reviewing these against the ideas and themes identified in steps 1 and 2. It was at the fourth step that the team refined the first coding of themes to develop a three-level 'data structure' (Gioia et al., 2013) across four broad themes (see Figures 4-7, below). For example, while the initial coding had identified 'wider environment/ecosystem' as a fifth theme, it became clear with ongoing analysis that these concepts could be integrated into the other four themes.

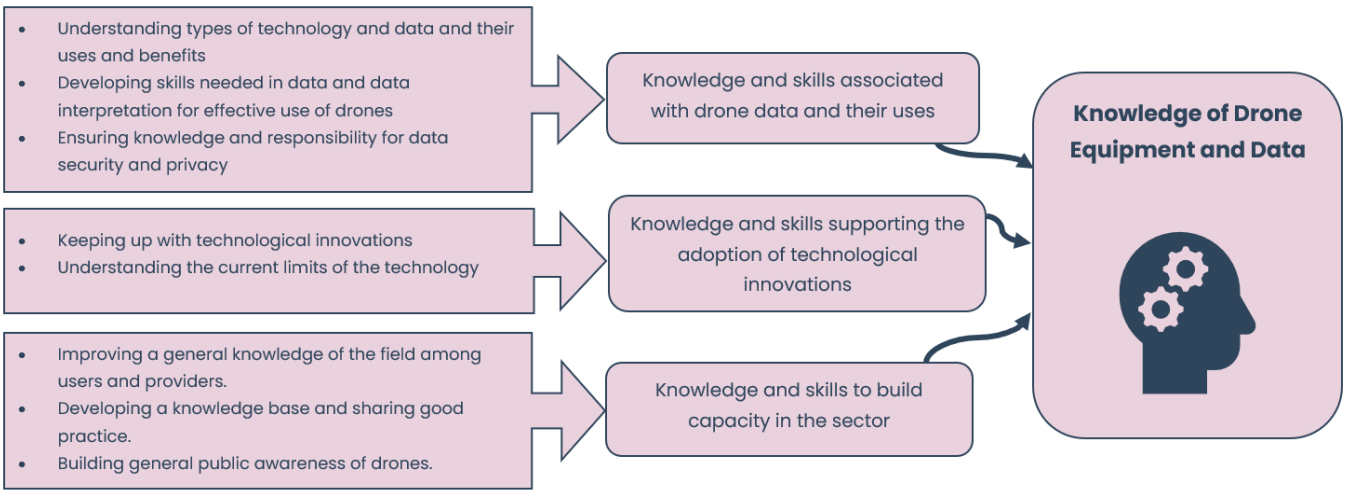

Figure 4: Concepts and Themes from the Focus Group Data1: Knowledge of Drone Equipment and Data

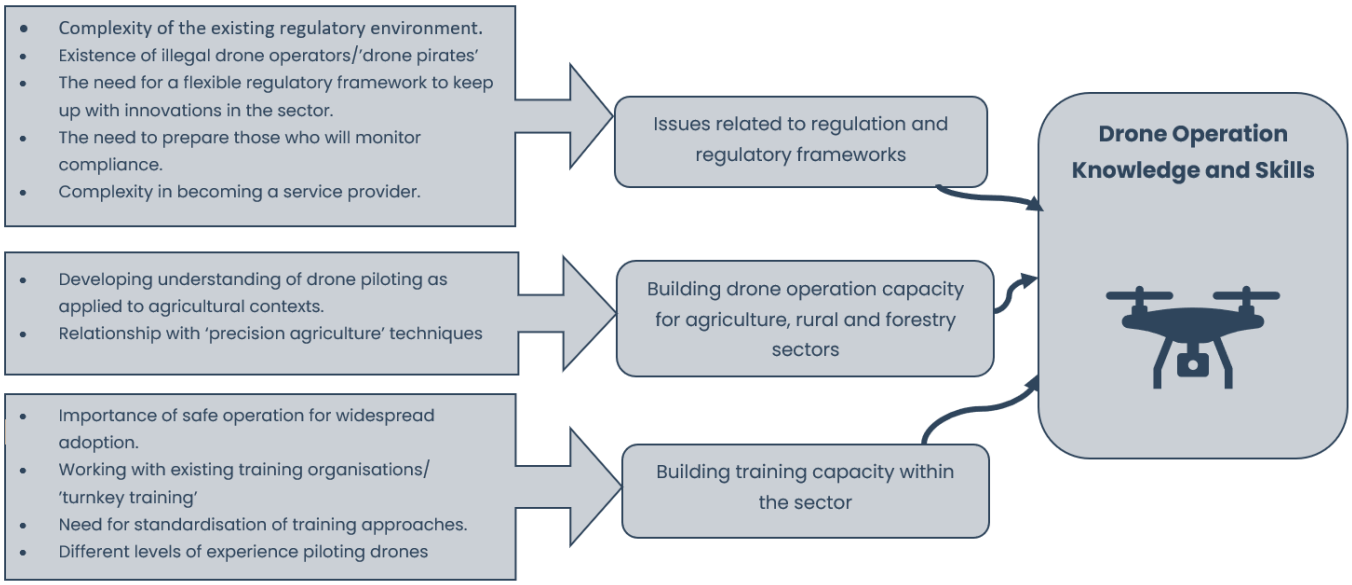

Figure 5: Concepts and Themes from the Focus Group Data 2: Drone Operation Knowledge and Skills

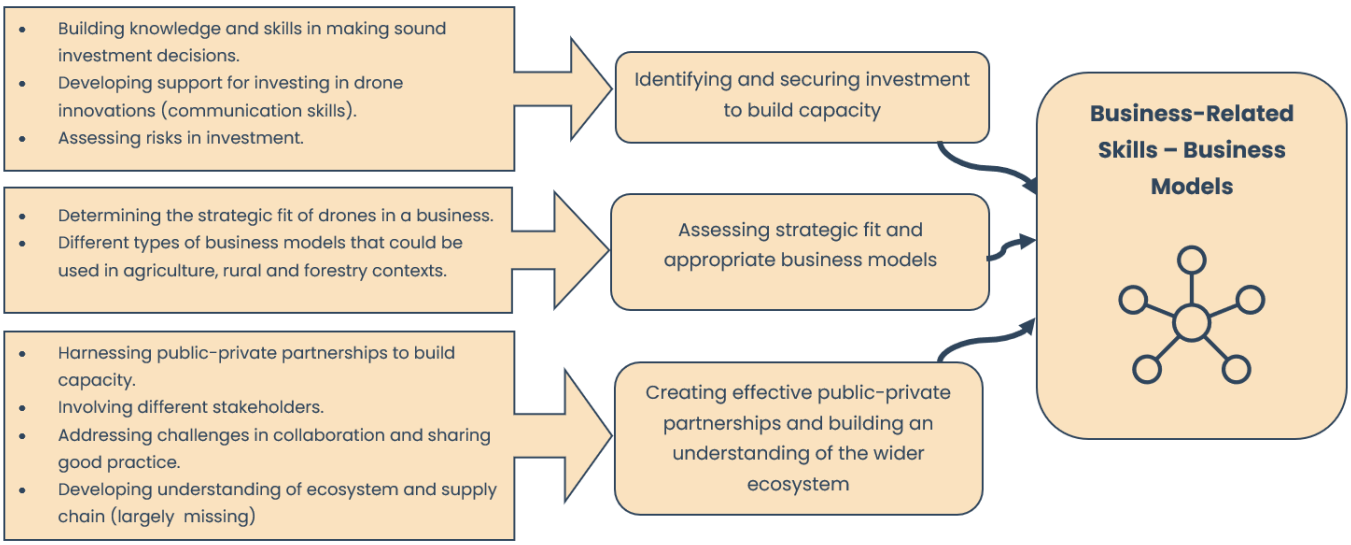

Figure 6: Concepts and Themes from the Focus Group Data 3: Business-Related Skills – Business Models

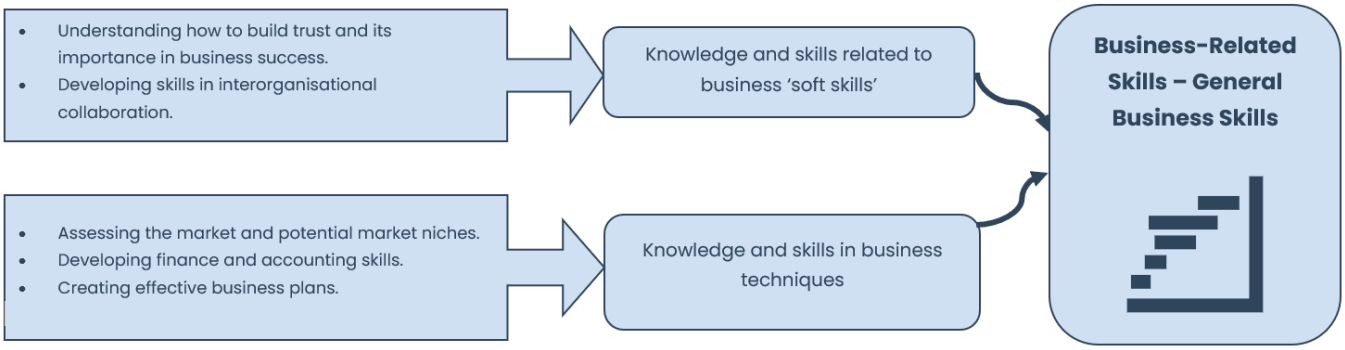

Figure 7: Concepts and Themes from the Focus Group Data 4: Business-Related Skills – General Business Skills

Before we discuss the results of the focus group analysis and implications for the design of the syllabus, we will explain the other phases of the methodology that informed the design.

2.3 Phase 2: The Learning Design Workshop

In Phase 2, a learning design workshop was organised to discuss the initial outcomes of the focus group analysis and to elaborate the syllabus of the open online course, considering four main elements: (1) personas (example learners), (2) learning outcomes, (3) structure and contents, and (4) assessment.

The development of **personas** was informed by the outcomes of WP1 - Task 1.1 Deliverable that was read by participants of the workshop. The aim of developing personas is to identify the profiles, learning interests and needs of potential learners in order to target the design of the course to their specific characteristics. Designing personas enabled participants of the workshop to appreciate the diversity among potential learners and to refine the types of stakeholders for whom the course would be designed.

The **learning outcomes** were designed considering a structured approach which distinguish them in knowledge and understanding, key (transferable) skills, cognitive skills, and practical and professional skills, in part inspired by Bloom's (1984) taxonomy.

The **structure and contents** were designed considering the requisites of a typical OpenLearn Badged Course: badged courses are courses that offer a recognition of learning based on the results of an

assessment (described below). The aim of badged courses on OpenLearn is to develop employability and professional skills. They are articulated in 24 hours of learning divided into eight weeks. Workload is calculated using a student workload analysis tool developed by the Open University that suggests an equivalent workload of 5,000 words maximum per week and is also inclusive of time allocated to activities students might perform other than reading, such as watching videos, performing analyses (such as a stakeholder analysis) or other related learning activities.

The **assessment** of an OpenLearn badged course is structured as two quizzes that are located at the end of weeks four and eight. The format of the assessment was discussed at the learning design workshop and some models of assessment were considered.

2.3.1 Learning Design Workshop - methodology

The Learning Design Workshop involved 14 participants in a hybrid mode (face-to-face and online), which included members of the project partners, representatives of the cases, and members of the OpenLearn editorial team. It lasted 1.5 hours and was recorded and transcribed via Microsoft Teams. During the workshop, Miro software was used to develop a collaborative design.

2.3.2 Information from Work Package 1

The results of the landscape analysis conducted in Work Package 1 also informed the development of the syllabus. The content of D1.1: *European Landscape of Drone Innovations and Technologies* was carefully analysed, and Section 4.1.1, below, reports on the outcomes of this analysis.

2.3.3 Analysis of existing courses

An analysis of similar open online courses including available ‘massively open online courses’ (MOOCs) and other online courses was conducted to compare the results of the learning design workshop with similar online courses. The object of the analysis was to identify the types of online courses available and to position the ICAERUS course in the panorama of the courses. The online search revolved around the keywords “business”, “drones” and the word “course”. The results were limited to few courses, which are presented and discussed in the findings. In the design of the syllabus, the comparison was then extended to courses related to entrepreneurship and business venturing and was focused on comparing different pedagogical approaches. This desk search was coupled with a second collection of recent texts on teaching material related to entrepreneurship and business venturing, which also informed the preparation of the syllabus. Section 4.3 of the report, below, provides the results of this analysis.

3. Findings from focus groups

Findings from focus groups are presented in two different sections. In the first, a summary for each focus group is presented to offer a snapshot of each Use Case. Then the results of the thematic analysis of the focus group data are detailed.

3.1 Summary of each focus group

This section presents a summary of each focus group based on the three main questions posed to participants, which are related to (1) barriers and challenges to the market uptake of drone technology and its use by end-users (e.g., farmers, forest owners, public authorities); (2) the business-related knowledge needed to apply the Use Case technology in an agricultural, forestry or rural business; and (3) the partnerships that could foster the adoption and scaling up of the use of the technology. Tables 2-8 summarise the findings of each focus group.

Table 2. Summary of Focus Group 1 – Greece – Drone Spraying Use Case

Question	Main points of the discussion
Barriers and challenges	• Legal framework prohibits the use of drones for spraying pesticides etc for environmental and public safety. There is a need for piloting/ experimentation to explore benefits of tech and to develop a legal framework around 'evaluation of PPPs (plant protection products) • Lack of standardisation in certification of training, uncertainty around flying regulations (height, path etc) and lack of operational knowledge have led to: a) uncertainty around choosing the most suitable drone type, b) misuse of the tech which created unintended consequences and more mistrust • Uncertainty around the benefits of the tech and costs.
Business related knowledge	• Understanding of pay-per-use models of 'renting drones'. Support users to become 'capable of judging [service providers] but also choosing the right equipment'. • Need for 'concerted action to educate the public' on the benefits of drones, in order to release their full potential. • Continuing training and education for drone operators. • 'it is important that training is accessible to all and covers the latest developments and advances in drone technology'. • Support business in crop protection and precision agriculture. • Training on crop protection, drone maintenance, calibration, testing.
Partnerships	• *Agriculturists* can help farmers understand and comply with the legal and regulatory framework to ensure that farmers use drones safely and responsibly. *Agriculturists* can learn from agricultural experts how to optimise the data collected by drones to increase farm efficiency and productivity. • Partnerships can help reduce errors of the past. • Collaboration between farmers and software providers to develop drones in a way that matches farmer needs. • Need for an official legal regulator and of robust framework for both the development of the technology and its use in agriculture and other uses (privacy in urban use). This requires interactions with the ministry.

Table 3. Summary of Focus Group 2 – Italy – Related to All Use Cases

Question	Main points of the discussion
Barriers and challenges	• Framework: Each activity, such as precision farming or aerial spraying, has specific regulations and limitations at both European and national levels. Compliance with these laws is crucial for operating within the legal boundaries. • Adoption and Training: Ensuring that farmers perceive the usefulness and ease of use of drone technology is essential for its successful adoption.

	Providing training and support for farmers to manage the data collected by drones can be challenging but vital for maximizing the value of the technology. • Value Proposition: Determining and effectively communicating the value that drones bring to the agricultural sector is crucial. Farmers need to understand how drones can enhance their job performance and contribute to their overall productivity, making it important to showcase the benefits in a clear and tangible way. • Crop Compatibility and Droplet Effects: When it comes to spraying activities, it is crucial to consider the compatibility of crops and the potential impact of droplets reaching unintended areas. Certain crops, such as organic or certified ones, have strict regulations regarding pesticide use, making careful planning and experimentation necessary to avoid any negative effects. • Privacy Concerns: The use of drones for data collection raises privacy concerns, especially when it comes to capturing images of farmland or workers. Clear guidelines and adherence to privacy laws are necessary to protect sensitive information and ensure that drones are operated responsibly.
Business related knowledge	• The key knowledge needed for applying technology in an agricultural business includes understanding the technology itself, economic issues, and legal frameworks. This knowledge is essential for potential users and entrepreneurs in the industry. • Business models are a crucial aspect, whether selling the technology as a product or offering it as a service/platform. Teaching through successful case studies can help entrepreneurs understand how to create a viable business model around the technology. • Farmers may not be direct users of the technology but can benefit from training to evaluate and choose drone service providers. This includes knowledge of data management, contract evaluation, and fair competition in the drone market. • Communication skills are vital for entrepreneurs to effectively communicate the benefits of technology to agricultural firms, especially small and medium-sized enterprises. Demonstrations and data showcasing the technology's potential impact can facilitate its adoption. • The course should consider different stakeholder profiles, such as technical profiles, business students, farmers, and serial entrepreneurs. Tailoring the content to their specific needs and facilitating cross-pollination among these stakeholders can lead to impactful outcomes.
Partnerships	• Industry involvement: companies in relevant sectors, highlighting the value of real-life cases and practical examples to showcase technology use. • Cooperatives and associations: trusted organisations in the agriculture sector were suggested as a means to support technology adoption and gain the trust of farmers. • Diverse representation: Representatives from software, hardware, regulatory authorities, irrigation certification agencies, and financial investors were recommended to ensure comprehensive involvement. Different levels of entrepreneurship, from start-ups to multinational corporations, were also deemed important. • End-user perspective: Considering the needs and preferences of end-users and integrating technology into their contexts were highlighted as crucial for successful adoption. • Concrete examples and multimedia: Utilising concrete cases, conducting interviews with investors and farmers' associations, and employing videos

	were proposed as effective ways to illustrate the benefits and practical use of technology.

Table 4. Summary of Focus Group 3 – Spain – Crop Monitoring Use Case

Question	Main points of the discussion
Barriers and challenges	• Legal limitations and restrictions: Existing laws and regulations pose challenges for drone adoption, requiring complex permits and licenses. • Economic challenges and ROI: High upfront costs and uncertain returns deter smaller-scale operations from investing in drones. • Lack of knowledge and education: Better education and accessible resources are needed to navigate complex drone regulations and procedures. • Access to airspace and permissions: Difficulties in obtaining clearances for drone flights hinder seamless integration into farming practices. • Advocacy for regulatory changes: Efforts to revise drone regulations should differentiate based on size and purpose, reducing restrictions.
Business related knowledge	• Understanding the specific agricultural applications: Users need to determine how drones will be used in their agricultural operations and what specific applications they aim to substitute. This requires a clear understanding of their business needs, costs, and potential benefits. • Knowledge of the agricultural business: Users must have a good understanding of their own agricultural business, including key performance indicators (KPIs) and cost analysis. This helps in assessing the cost-effectiveness of using drones and evaluating the potential impact on their business. • Availability of support and information: Farmers may not have the technical expertise or resources to operate drones on their own. They often rely on external companies or advisors who have the knowledge and can provide support in terms of information, services, and decision-making. • Need for a central source of information: Lack of centralized and up-to-date information is a challenge in the drone industry. Having a comprehensive online resource, such as a library or launchpad, with basic information, tutorials, and guidelines would be beneficial for beginners and those entering the market.
Partnerships	• The course should emphasize the importance of building partnerships and networks with industry experts, public institutions, and established companies in the agricultural sector. This can help provide exposure, knowledge sharing, and potential business opportunities. • Gap related to a link between users of drones and providers to create business applications • Public institutions could create visibility of agricultural needs towards the private sector

Table 5. Summary of Focus Group 4 – France – Livestock Monitoring Use Case

Question	Main points of the discussion
Barriers and challenges	• Regulations / restrictions on flight rights, range /height / paths • Uncertainty around how the landscape, type of farm and weather can limit (the benefits of) drone use. • Uncertainty around benefits of use, suitable drone type, cost of purchase, training & maintenance needs. • Need more research on understanding the benefits of the technology in new areas such as breeding that could detect problems ‘before human eye can’, (some existing research on algorithms could enable that).

Business related knowledge	• Drones can be purchased by coops (Cumas) whose members can be trained and support farmers with their use. • Training/education should be for all: breeders, advisers, companies, consultants (e.g., consultants tour plots and can communicate to breeders the benefits of the technology). • Levels of existing knowledge on potential uses and benefits are very low. They want to learn more about the benefits by experimenting/applying /piloting the use of drones. • How to capture and analyse data for efficient use. • Knowledge and understanding around obsolescence of drones and the implications of that. • Knowledge and understanding of forming partnerships for tech use, re-use, that are based on efficient cooperation and trust. • Learning from cross-industry applications of drones.
Partnerships	• Compounding more research evidence from the French institute & other independent organisations (e.g. Chamber of Agriculture) that full-proof the use of drones for the specific application and of their versatility can convince users to adopt. • Initiate tests and tech piloting by partnering with drone manufacturers and users from other industries. • Partnerships with agricultural social security (ASS) to jointly research with research institutes and ICAERUS the benefits of the use of tech. ASS can support adoption /diffusion through financing. Another source of financing could be the 'wolf action plan' (surveillance of areas of attack). • Past experiences with partnerships (with ASS) suffered from bureaucracy, delays and lack of sufficient funding. • Potential partners: the institute, chamber of agriculture, the advisors, ASS); there is a need to have one actor that will 'takes the risk of purchasing, who makes the technology available during small test phases and who helps other actors to know if they like it and if they can buy it afterwards'.

Table 6. Summary of Focus Group 5 – Lithuania – Forestry Biodiversity Use Case

Question	Main points of the discussion
Barriers and challenges	• Sector and field in early stages of development. • Regulations, rules and compliance are perceived to be the greatest barriers for adoption. • Unofficial flying is an issue. • Lack of promotion, communication and public education are issues (i.e., general awareness). • Lack of understanding how use of drones fits within a general strategic plan for a user company).
Business related knowledge	• Operator training and knowledge of rules and regulations (compliance) • Need a well-developed service sector (business model) to provide service to farmers (less costly, more efficient). • Need training on how to fit a drone approach within a more general organisational strategy. • Mixed responses regarding focus of training: some wanted basic understanding of drone tech, operation and regulation, and others thought more should be done to develop understanding of effective business models.
Partnerships	• The sector's current cooperative approach is more favourable than competition. • Partnerships and cooperation to support sharing of good practice and knowledge.

	• There are several areas where partnerships fill a need (piloting, data acquisition, data processing). For example, data processing can require supercomputers to analyse. • Successful adoption of drone technology requires a system of many different stakeholders and contributors, for example, to propose solutions once a drone has identified an issue. • Public-private partnerships are key.

Table 7. Summary of Focus Group 6 – North Macedonia – Rural Logistics Use Case (A)

Question	Main points of the discussion
Barriers and challenges	• Financial costs for implementing drone technology a major barrier for farmers (one participant mentioned the need for state intervention or assistance with cost). • Older farmers may also not want to adopt the technology. • Farmers need more information to understand the benefits of drones (e.g., via demonstrations) and how to incorporate them into their agribusinesses (e.g., to operate them or to hire a service provider). • Most are smallholder farms, which can make it difficult. • Lack of knowledge of regulations.
Business related knowledge	• Information on how to use drone technology effectively, whether as an owner-operator or via a service provider. • The benefits of using drones in agriculture and their impacts on profitability (e.g., reducing pesticide spraying costs and production costs, crop monitoring, or in improving efficiency). • Regarding rural logistics benefits in making repairs to broken vehicles in fields or accessing hard-to-reach areas. • Training should cover the needs of both the service operators and the people using the service (farmers should understand the benefits). • Link this to 'precision agriculture' trends.
Partnerships	• Farmers could pay private providers an annual fee to have access to rural logistics services. • Companies should work with groups of farmers (this would also improve the financial sustainability of the company if they can reach a critical mass of customers). • Private companies, non-governmental organisations and the public sector should work together. • Public sector should provide funding and regulation.

Table 8. Summary of Focus Group 7 – Greece (North Macedonia)– Rural Logistics Use Case (B)

Question	Main points of the discussion
Barriers and challenges	• Dominance of large companies limits distribution opportunities for smaller innovative companies in the drone market. • Lack of education and knowledge hinders the implementation of safety regulations and limits awareness of drone applications in agriculture and related industries. • Misconceptions about drone stability, endurance, and safety pose obstacles, particularly in sectors like oil and gas and firefighting. • Regulatory frameworks, including airspace limitations and permissions, need improvement to facilitate wider adoption of drones. • Interdisciplinary knowledge transfer, systematic training, and addressing safety concerns are crucial for integrating drone technology effectively into different industries, including agriculture and environmental monitoring.
Business related knowledge	• Integration of AI and Machine Learning: need for implementing AI and Machine Learning algorithms to enhance drone operations, automate

	tasks such as route tracking, and improve the quality of data analysis and decision-making processes. • Utilisation of Advanced Technologies: The integration of technologies such as Edge Computing, IoT (Internet of Things), and satellite data is highlighted as important for optimizing drone operations, especially for Beyond Visual Line Of Sight (BVLOS) operations and pollution monitoring. Participants also mention the potential benefits of 5G networks for communication protocols. • Business Knowledge for Efficient Deployment for efficient deployment of drones in agricultural businesses. This includes determining suitable regions for deployment, establishing permanent sites for take-off, landing, and maintenance, training pilots, and automating drone operations to collect data with minimal effort. • Decision-making Systems and Data Analysis: need for technologies related to decision making, as well as leveraging AI and machine learning algorithms to improve the quality of results. • Collaboration and Integration: various technologies and expertise to achieve productive drone operations and provide efficient and integrated services to end-users.
Partnerships	• Private companies and SMEs are hesitant to seek partnerships. Copyright issues and concerns about sharing innovative knowledge are highlighted as potential barriers to collaboration. • Partnerships are crucial for overcoming technical weaknesses and integrating new technologies, expanding the applications of products. • Companies, particularly SMEs, prioritize economic sustainability and experimental implementation, while the responsibility for basic scientific research may lie with public institutions.

3.2 Thematic analysis

3.2.1 Knowledge of drone equipment and data

Stakeholders across all seven focus groups identified knowledge of drone equipment, technology and data as primary learning needs in order to develop drone capabilities within their local agricultural, forestry and rural sectors. Such knowledge was for the use of drones by owner-operators, for potential customers and service users, or for agricultural collectives that could be formed. This included different types of drone models and related equipment and in their potential uses and capabilities or limits.

Requirements for **general knowledge of the field** and its innovations came from both expert stakeholders and potential users of the technology.

> *One problem with the lack of education is that many drone buyers do not know the capabilities and limitations of their drone. This can lead to disappointment or frustration with the technology, as buyers may not be able to achieve the results they expected. In addition, many buyers are unaware of the various regulations and laws that apply to drone use, which can lead to legal problems. (Greek focus group member)*

> *[A]s a young farmer myself, if I would like to use drones, I have no idea what the first thing I should do. Should I buy one? Is there a company … that I can hire for such a service? So, the information should be more accessible for us farmers to begin with and that way we will be on a better path. (North Macedonian focus group A member)*

3.2.1.1 Data Knowledge

Additionally, **technology and data** were identified as important areas for learning, including the types of data that could be generated, what analyses could be performed and how to interpret the data. For example, a member of the French focus group noted that using a drone for livestock monitoring would offer a fresh perspective on the herd:

> *[I]t's how we get the actors used to using this new data feedback or this new information, this perspective seen from the sky, if I can say. (French focus group member)*

Members of the Italian focus group noted how **data and data interpretation** could inhibit adoption of the technology:

> *Because if you have this kind of tool that can collect a lot of information, a lot of data, not thinking about the spraying part but the drone that collects all the information. How can the median farmer, the average one, how can they manage all that data? (Italian focus group member)*

Moreover. the technology is ever evolving, as a member of the second North Macedonian focus group explained, and drone users will need to keep up with **technological innovations**:

> *It should be pointed out that drone technology - it's not just hardware. The business-related knowledge that is mostly required nowadays, is the implementation of AI [Artificial Intelligence] and Machine Learning algorithms to drone operations that will act complementary with the mounted drone components, essentially adding value to this technology. For instance, it won't be a prerequisite for the drone-user to keep track of its route, since this procedure could be fully automated. (North Macedonian focus group B member)*

Data security and privacy were also mentioned by members of some groups. For example, a member of the Italian focus group noted the complexity in identifying who was responsible for data security:

> *Legally speaking, the liability for the management of the data, images, privacy data, sensitive data, etc., is on the shoulders of the operator. Which is not necessarily the owner, it's the operators. So, the one that provides for the service, which is not necessarily the pilot, the remote pilot. It's the operator. Realistically, it's a company. It could be also the single farmer, but it would be complex to say something like that. (Italian focus group member)*

For stakeholders in the French focus group, it was also important to communicate the **current limits of the technology**:

> *There is nothing automated yet, it's an eye in the sky. So, today a farmer's eye is doing a lot of things and we can imagine things like counting animals, et cetera. You can imagine a lot of things, but today, [in the end], it's just a camera that flies. (French focus group member)*

3.2.1.2 General public awareness and broader capacity building

Developing a **general public awareness of drones** and their uses was sometimes seen as a key factor in successful capacity building within the local sector. Building a public understanding of the potential uses in agriculture, forestry and rural areas was considered to be one way to encourage their use and reduce concerns or confusion that could prevent successful adoption across the sector. A member of the Lithuanian focus group noted such campaigns could address what might be considered 'conservative attitudes'. Similarly, 'large campaign[s] to enable the wider rural population to use these [drone delivery] technologies' were considered important by members of the North Macedonian A focus group.

Public awareness campaigns could emerge through collaborative partnerships, which could support the **development of a knowledge base** and support innovation:

> *Sharing good practice and knowledge leads to better results. (Lithuanian focus group member)*

> *[We need a website] that is an accumulator, that contains videos, not only to fly or do things in a safe way but more, such as how to start using a drone as a business, you will have to do the following things, learn how to pilot, buy a drone, etc., etc. I think this is something that is missing that is very important because imagine the people who do not have so much technical knowledge, I'm sure that there will be more interest in the use of drones. For example, saying, 'this is going to be the future and I can help'. (Spanish focus group member)*

> *Collaboration … includes sharing information on the latest technologies and advances in the field, as well as best practises and lessons learned. In addition, cooperation may include collaboration on research and development projects that may lead to the development of new technologies and innovations that improve drone performance and safety. In addition, collaboration can also help to ensure that drones are used in accordance with laws and regulations, and also promote public understanding and acceptance of the technology. (Greek focus group member)*

Indeed, researchers are considered important stakeholders in capacity-building efforts in the sector with innovation closely tied to knowledge generation and sharing. Beyond the uses of drones, however, an important area for learning was in drone operation, discussed next.

3.2.2 Knowledge and skills in drone operation

A separate set of learning needs related to the **safe and effective operation of drones,** which featured prominently across the different focus groups. Drone piloting and certification were strongly linked to

knowledge of regulatory contexts in each of the focus group countries, with concerns that public safety could be compromised, or in some cases, could encourage **illegal operators** (termed 'drone pirates' by members of the Spanish focus group) as viable options. A similar concern was raised in the Lithuanian focus group:

> *Specifically for large-scale farmers, and forest owners, one of the obstacles is unofficial flying without correct permits, which makes it difficult to keep track of and regulate. Almost all of the flights done by farmers are not official or regulated. (Lithuanian focus group member)*

Safe operation of drone technology was considered an important aspect of training across all potential users and was often considered a **barrier to widespread adoption**:

> *Another barrier to the use of drones in crop spraying is the lack of knowledge and understanding among farmers. Many farmers do not know how to properly operate and maintain a drone or how to correctly apply pesticides with a drone. This can lead to misuse or abuse of the technology, which can be harmful to crops or the environment. (Greek focus group member)*

In some contexts, skilled drone operators were already available, with certification processes and training organisations in place. Drone operators come with **different levels of experience**, as a member of the Spanish focus group noted, '[T]here are these massively high, really professional [operators] and then there are others that are working more with low cost [drones] or as a hobbyist.'

However, having piloting skills did not necessarily mean an easy **move to becoming a service provider**. Another Spanish focus group member explained:

> *Take me for example, I have the drone 'pilot license' and that of 'Radio Controller' ['Radiofonista'], but I don't have 'operator'. What is 'operator'? This is when you listen like a controller from company 'Vueling', and to fly the drones as a business you can't have this because you can't write invoices. (Spanish focus group member)*

3.2.2.1 Training for operators

Focus group members placed importance on scaling up of training and building an understanding of **how drone piloting applied** to agricultural, forestry and rural contexts. In some cases, this type of drone usage was seen as building on existing innovations in 'precision agriculture' – a term that emerged in some of the focus groups.

> *[F]or those [farmers] who want to develop in the future, the use of precision agriculture is beneficial. As an institution responsible for spreading information and opportunities, we need the training to transfer and train farmers on all these new technologies. (North Macedonian A focus group member)*

A number of contexts already had **established training organisations** more generally within the sector, with focus groups including their representatives. Stakeholders in the French focus group discussed 'turnkey training', that is, a train-the-trainer model that could provide scaled up education and training within a short time.

Additionally, standardisation and harmonisation of training across Europe was mentioned in the North Macedonian B focus group:

> *[T]he training of pilots it is an important issue and should be clarified, specified and unified globally or, at least, across Europe. This is the general way to 'convert' an idea into a service. Training should be easily accessible. A stakeholder should be able to ask*

for training courses and the corresponding information (such as the total cost, period of time required to complete the courses, pilots, etc.). (North Macedonian B focus group member)

3.2.2.2 Knowledge of regulations and the regulatory environment

Many groups discussed the need for a **flexible regulatory framework** that could adjust to the speed of innovation and change in the sector:

[T]he legal regulation of drone technology is a significant obstacle that must be overcome in order to fully realise the potential of drones. This requires the creation of a comprehensive regulatory framework that takes into account the various challenges and considerations, including technological advances and the changing needs of the industry. (Greek focus group member)

Knowledge of the **regulatory environment** was a key area for education and training, not just for potential operators, service providers and users, but also for policymakers more generally across Europe to develop more harmonised regulation. It was clear that, while common legislation was in effect, there were several regional variations that could impact on the delivery of drone-based services.

For example, current EU regulations might have been put in place for larger aerial vehicles (e.g., planes), thus introducing further **complexity** into the existing regulatory environment:

We have to consider that the negotiation concerning the drafting of EU norm [for crop spraying], the regulatory directive mainly, can last also for a decade. So, it's realistic that it started in very early 2000. At that time, there weren't proper operated drones. So, the limits that the member states issued on aerial spraying is prohibited, probably is due to that rationale. (Italian focus group member)

Additionally, focus groups noted education needed in the wider environment for regulatory mechanisms to be effective. For example, stakeholders in the Greek focus group mentioned the need to prepare and educate those who **certify use and monitor compliance**:

It is also clear that authorities have not been fully prepared for the rapid development and widespread use of drone technology, which can lead to a lack of oversight and enforcement. To overcome these obstacles, it is important to further educate and train drone operators and ensure that government agencies are prepared and equipped to regulate and oversee drone operations through standardisation and certification of drone pilots and maintenance personnel. (Greek focus group member)

The broad range of stakeholders represented across the focus groups (e.g., drone service providers and operators, farmers, researchers, drone associations) allowed for identification of many different learning needs in terms of drone understanding and operation. A similarly wide number of business-related training needs were identified by focus group members. We now turn to these themes.

3.2.3 Business-related training and development

Given that one of the focus group questions asked participants to specify potential business-related training needs, many such areas were identified in the discussions. These can be grouped into two broad sub-categories: (1) Understanding potential business models; and (2) General business skills, including developing an effective business case.

3.2.3.1 Understanding of potential business models

Potential business models for building capacity within the sector was a common theme in the focus group discussions. These often related to assisting farmers, foresters and other rural stakeholders understanding how the use of drones could complement or improve an existing business approach. Foundational

knowledge in how to analyse the impact of drone technology on an agricultural or rural businesses and methods for choosing the right drone for the intended use – in effect, **investment decision-making** – were mentioned frequently by all focus groups.

> *A system of continuous education would help producers understand the different types of drones available on the market and select the right equipment for their specific needs. This could include information on factors such as flight time, payload capacity and sensor capabilities, as well as the cost and maintenance requirements of the different drones. (Greek focus group member)*

Understanding of the strategic fit of drone technology within the business linked strongly to types of business models, which differed depending on context. For example, referring to a large agricultural business purchasing drones, one stakeholder in the Lithuanian focus group discussed how it is essential for businesses to understand the **strategic fit of drones** in their business:

> *Another problem is the lack of a clear plan and strategy. To gain the maximum benefit from this technology, it is not enough to buy a drone and train a pilot, it is necessary to have a clear plan of action and purpose, answers to the questions of what the drones will be used for, and what results are expected. There are cases where organisations buy a huge fleet of drones but don't benefit from them due to poor planning or lack of knowledge. (Lithuanian focus group member)*

Training and education needed to clearly communicate the benefits drone technology could offer farmers, foresters and other rural stakeholders and the potential impact it could have on existing agricultural practices. Effective communication skills would also help to **build support among potential investors** and other stakeholders:

> *Without a clear understanding of how drones can improve their operations, many companies may not see the value of investing in this technology. This lack of understanding can also make it difficult for companies to justify the investment in drone technology to stakeholders, such as shareholders or investors. (Greek focus group member)*

Understanding and managing financial risks from investing in new technology was highlighted in a number of the focus group conversations. For example, a French focus group member suggested that initial **investment risk** could be handled by organisations other than farmers:

> *It's [a state organisation or non-governmental organisation] who takes the risk of purchasing, who makes the technology available during small test phases and who helps other actors to know if they like it and if they can buy it afterwards. (French focus group member)*

While developing skills in performing 'risk analyses' was not specified in the focus groups, it is clear that several of the groups found risk assessment an essential area for training and education. Risk was often framed in financial terms (and environmental risk noted in a few groups), which inevitably led to discussions of funding and potential business models.

3.2.3.2 Different business models

Understanding fit with an existing business, i.e., the benefits (or risks) drones could offer, also related strongly to knowledge of and access to funding. Each group cited funding as a barrier to widespread adoption and capacity building of their local drone sector.

For example, a member of the Lithuanian focus group discussed how money could be saved by offering it as a **service to farmers**.

> *…a fully integrated service sector should be developed in this field, providing farmers with crop maintenance or other drone-optimised processes. Organisations providing this service would save farmers money, as subscribing to the service several times a year would be cheaper than buying the equipment, training and hiring pilots. (Lithuanian focus group member)*

For some groups, a **service-user model** was considered a viable option, for example:

> *We have many villages and rural areas in our country that are completely cut off, especially in certain parts of the year, where rural logistics is a complex problem. The part with the project of delivering medicine and documents is the only way to access those people. To make it commercially viable, there should be companies that would work for the farmers themselves, helping them, and with the income they would have, they could further work for the community, for people who would not be able to afford transportation with drones for medicine, anything, and that would make the entire system sustainable. (North Macedonian A focus group member)*

> *So, realistically, drones will be operated by specific companies that will provide for the services to a number of farmers. Not only for reasons related to the knowledge you need in order to operate them, but also for all the rules that shall be applied, among which there are also the privacy rules.* (Italian focus group member)

Renting business models were also considered:

> *[C]ompanies can also consider a pay-per-use model or renting drones instead of investing in owning them. This can help them reduce the initial investment and is more suitable for companies that only need drones seasonally or occasionally. (Greek focus group member)*

In some contexts, there were already **existing organisations** that could serve in this capacity – either because they already provided services to farmers or were state/NGO organisations created for this purpose:

> *I think that there are already large businesses that are already dedicated industrially to the support of farmers. It is to say that many small-scale farmers or cooperatives have access to companies that can give solutions to their problems. (Spanish focus group member)*

> *Well, since these are uses that may be on a case-by-case basis, would it be possible to offer rental? And then, if there is a real interest in the given system, to go towards the acquisition of the drone. I don't know if the Institut de l'Elevage or the chambers of agriculture could already have about twenty drones and if they could lend them. And then, if the farmers like it, the Institut de l'Elevage or the chambers of agriculture could help the farmers to find financing. (French focus group member)*

Nevertheless, several challenges were mentioned by group members in developing a successful model. For example, a member of the Spanish focus group noted the high costs involved in providing this **service as an owner operator**:

> *For me I believe that I see the … theme of costs not only for the costs of buying a drone but also for the bureaucratic process with drones. In this you have to apply for papers to fly in CTR zones for Urban zones and in that, firstly you will have to pay for a legal advisor and later you will have to have an agreement that shows that you understand what you are doing. All of this is not easy, I have a friend that is a pilot that flies for Netflix, for*

> *Redbull and for all of the companies of this type, and he has the client behind him who can pay these bills. And here I have the same time the same problem, to sell a day of work to fly and perhaps make an advert or publicity it is very difficult to say, my day of work could be 500 euros, plus the different type of drones, plus the different type of zones and then to pay for these different types of permissions to record. Afterall it is very difficult to explain all of this to the people and still even I don't understand how it works. This is an incredible barrier to start, for everybody. (Spanish focus group member)*

Members of the Spanish focus group noted that benefits, uses and costs for flying and operating different types of drones varied, but that these fell into different regulatory categories (e.g., heavier versus lighter drones), which impacted on potential costs.

3.2.3.3 Public-private partnerships

Funding and investment were also strongly linked to the regional policy and regulatory environments. **Public-private partnerships** featured frequently as methods for building capacity within the sector:

> *Partnerships are essential for progress in this field, as the whole process consists of several complex parts, whose experts working together can ensure the efficient and smooth execution of the overall process, as in many cases it is not enough to sell the technology to the user, but it is also necessary to carry out the analytical part, come to a conclusion, and propose solutions to the problems found. Partnerships between the business sector and public bodies are one of the most important aspects to develop and expand the usage and value of drones in all industrial sectors. (Lithuanian focus group member)*

In the Greek context, **'agriculturalists'**, agricultural experts and advisors, were seen as potential ways to develop knowledge and understanding in the sector:

> *Using agriculturists as agricultural advisors for the use of drones is an innovative approach that can bring many benefits to agriculture. Agriculturists, as experts in the field, are well versed in the latest technologies and advances in the field, including the use of drones. They can provide farmers with valuable advice on how to effectively integrate drones into their operations, from crop monitoring to precision spraying. (Greek focus group member)*

However, **sharing good practice** among different stakeholder groups was not always universal:

> *[P]recision agriculture applications are limited and generally are not progressing. The main reason is that farmers are not familiar with the various drone applications in agriculture and how to exploit this technology. In addition, they do not have the appropriate training to deploy these systems, whereas the agriculturalists intend to promote the drone technology, but keeping the knowledge for themselves and not transfer it to the farmers. (North Macedonian B focus group member)*

Interestingly, **few groups mentioned environmental sustainability** as an important focus for education and training. Focus was most strongly placed on the beginning of the business life cycle, and in some cases the scaling up of a business. However, while a few groups did discuss the need to have 'maintenance' suppliers and those who could repair drones, environmental sustainability, as well as an understanding of the wider supply chain, did not factor heavily in discussions. This is an important omission from the focus group conversations and highlights a crucial training need more generally across the different regional sectors.

3.2.4 General business skills

As noted earlier, communication with stakeholders factored heavily in how to engage different stakeholders in adopting new uses of drone technology in agriculture, rural and forestry sectors. It is reasonable to assume, therefore, that communication skills might be important learning needs for those wanting to encourage adoption. This brings us to a final set of training and education needs that would assist potential service providers or indeed owner-operators to successfully integrate drone technology into their businesses.

3.2.4.1 Developing trust and engaging with stakeholders

Developing trust within the local agricultural community and with local stakeholders is a key business skill. Building trust is often linked to being seen as a legitimate actor within a context or being perceived as a legitimate stakeholder. For example, trust emerged as an important aspect of developing effective training in the Italian focus group. Here, two members of the group discussed how organisations serving an agricultural sector could build on existing legitimacy to offer effective training and development:

> *Because if you find a company which is in the sector, in, for instance, of production, fruit and vegetable and so on, which is interested in the development of technologies, they can bring real cases. (Italian focus group member A)* […]

> *I think also co-operatives in the agriculture sector and associations of farmers [would be good partners in training and education]…[b]ecause they definitely are on the side of the farmers, and so they need the farmers to trust them, and they could be reliable partners. (Italian focus group member B)*

In the French focus group, a member noted that consistent messages from different sector stakeholders was one way to build trust:

> *What would be interesting is to have several actors asking the same question to know if the conclusion is the same. So, it's true that it's good that [this organisation] is working on it, but it would be good if chambers of agriculture or other sectors were also working on the subject. But with an external point of view, to help to complete. (French Focus group member)*

3.2.4.2 Building market understanding

Understanding of the market and knowledge of potential market niches were also important areas of general business knowledge mentioned by focus groups. For Lithuanian focus group members, understanding customers and their needs, as well as the **market potential** for different business models were key to successful capacity building.

One of the focus group questions asked participants to identify barriers and challenges to developing the drone market and securing market access. Responses were often related to potential customers' lack of knowledge of the benefits, burdensome and complex regulation and funding scarcity – all mentioned earlier as important themes to address in education and training. Education and training should not only focus on educating potential customers (or providers), it should also help potential providers better understand **customer needs and potential market gaps** – essential skills for successful marketing of drone services and innovations. For example, in the Italian group, one member stated:

> *If I live in a rural area, which extends to farmers that produce in an extensive manner, they don't have any interest in developing technology. So, it would be interesting to find how many people may be interested, considering also that there are a lot of technologies coming up from agricultural [innovations]. (Italian focus group member)*

A member of the French focus group identified a **potential gap** in the regional market:

> *The way I see this, actually, I think there is a massive gap for a company to enter...we have these specialized companies that walk you through the process, they do the whole service for you and they give it to you, they make it easy and that's it…[T]his would be a marketing campaign for your company, because this brings more and more clients passing through your door. I think there is a really a gap for this in the market because people don't know about [drones], or there are not many of them. Or maybe a combination of both, I think...Are there many people that do this kind of business or offer this kind of service? (French focus group member)*

In the Spanish focus group, a member noted how providers should understand what drones will substitute, linking this to understanding business 'KPIs' (**Key Performance Indicators**):

> *If somebody wants to enter the world of drones to use it in the agricultural sector, it is necessary to know, for what they are going to use it, what are the applications that would like substitute, and in this level, it should be understood well how much they are going to use it, at what times and with which costs, to know if the use of the drone will be cost effective in their business or not. They should have a good understanding of their own business in terms of KPI's and as part of a study by a drone business they can say how much they will lower their costs for their business, or not. (Spanish focus group member)*

A member of the North Macedonian B focus group discussed **market share** and the impact of partnerships on scaling up the market for these technological innovations:

> *[C]ompanies have to consider their share in the drone market and how to attract new customers that will increase their revenue. Nevertheless, the partnerships are affecting the scale-up of technology and it is probably the only direction towards progress. (North Macedonian B focus group member)*

3.2.4.3 Fostering collaboration skills

As noted throughout this discussion, the theme of partnership and collaboration surfaced strongly in focus group conversations (and not simply due to a question on potential partnerships). **Collaboration** was seen as an integral way to develop capacity within the sector, for example:

> *All the factors involved in this process, such as the government, companies such as AGFT, which works directly with such services, and the non-governmental sector working on rural development projects, need to work together, and the government should help financially and with regulations for implementation for all those processes. (North Macedonian A focus group member)*

The Greek focus group members discussed how different market stakeholders (manufacturers, universities and researchers, drone operators, service providers and regulators) could **collaborate** to build a viable and growing market (a key focus group question):

> *By sharing knowledge between these groups, the industry, as a whole, can improve and better adapt to the changing market and technology. It can also help identify best practices and solutions that work in different scenarios and avoid mistakes made in the past. In summary, knowledge sharing between manufacturers, universities and drone market representatives is crucial for the growth and development of the industry. It can help improve drone performance, safety and compliance, and also drive innovation. (Greek focus group member)*

Therefore, developing **skills in collaboration** is an equally important aspect of education and training to support technological innovation.

3.2.4.4 Improving financial skills

Similarly, though focus group members did not specifically mention financial skills as among key business skills to develop, the priority seen in **building investment** in these innovations would necessitate a keen understanding of finance and accounting. For example, a French focus group member discussed 'planned obsolescence' of drone equipment and how it would factor into business plans.

> *And then, for me, it raises the question of programmed obsolescence, and the little bit of knowledge that I have acquired…about drones. I understood that there was a big programmed obsolescence on drones and where, in fact, the models have a very short life span…you can't find spare parts anymore. So how can we manage this? In the agricultural sector where indeed, we may not buy a drone every 2-3 years. Or it has to be included in the investment plan. (French focus group member)*

Such considerations are integral to estimating **asset depreciation** in financial balance sheets. They are also important considerations in creating a robust business plan, which leads us to our final theme.

3.2.4.5 Designing an effective business case

All of these skills were seen as essential aspects of developing an **effective business case**, clearly identifying the benefits and costs of drone use, addressing key customer needs and showing how drones can improve performance. For example:

> *I think we should target specific companies, for example, if they are involved in grape production, we should approach those companies directly and explain to them the benefits they would have from using drones for disease and pest control, with specific numbers on how it could reduce their spraying costs. For example, for a 200-300ha vineyard, one spraying could cost them 1000 euros. We should show them the literal application of the drone and how it could reduce production costs and increase efficiency. (North Macedonian A focus group member)*

> *[A] fully integrated service sector should be developed in this field, providing farmers with crop maintenance or other drone-optimised processes. Organisations providing this service would save farmers money, as subscribing to the service several times a year would be cheaper than buying the equipment, training and hiring pilots...it would be a faster method since the company would carry out the whole process, from scanning the fields to processing the data and presenting the results. (Lithuanian focus group member)*

> *So, in order to use these technologies, [farmers] need demonstrations, figures, data about what these new technologies can bring through their business. (Italian focus group member)*

4. Discussion and implications for learning

4.1 Summary of results of focus groups

The results of the focus group analysis point to four broad areas of learning linked to issues identified in the focus groups:

- Knowledge of drone equipment and data
- Knowledge and skills in drone operation
- Business-related training and development linked to the development of business ideas
- General business skills to support successful business development

As noted in the methodology, the focus group members were asked to identify gaps and barriers in the development of the sector, as well as potential partnerships and learning needs (including those specifically related to business development). While some specific areas for training and development were identified in the focus group discussions, many of the learning needs were linked to those barriers and challenges noted by the participants (see Figure 8, below). They were not explicitly identified as 'learning needs' in the focus group discussions, yet they are clearly crucial aspects of training and development (for example, the safe operation of drones and an understanding of how drones can benefit agricultural, rural and forestry sectors).

Moreover, while some focus groups did identify specific business-related training required, such as businesses needing to understand how drones could fit strategically within the business, many of the needs emerging from the analysis were again related to challenges, barriers and issues identified by the focus groups. For example, successful inter-organisational partnerships and engagement with different stakeholders in the sector can be supported through knowledge and skills in collaboration and an understanding of how to build trust with community stakeholders.

As such, the 1st level concepts that were identified in the focus groups (e.g., as noted in Figures 4-7) can be considered as barriers and gaps to be addressed.

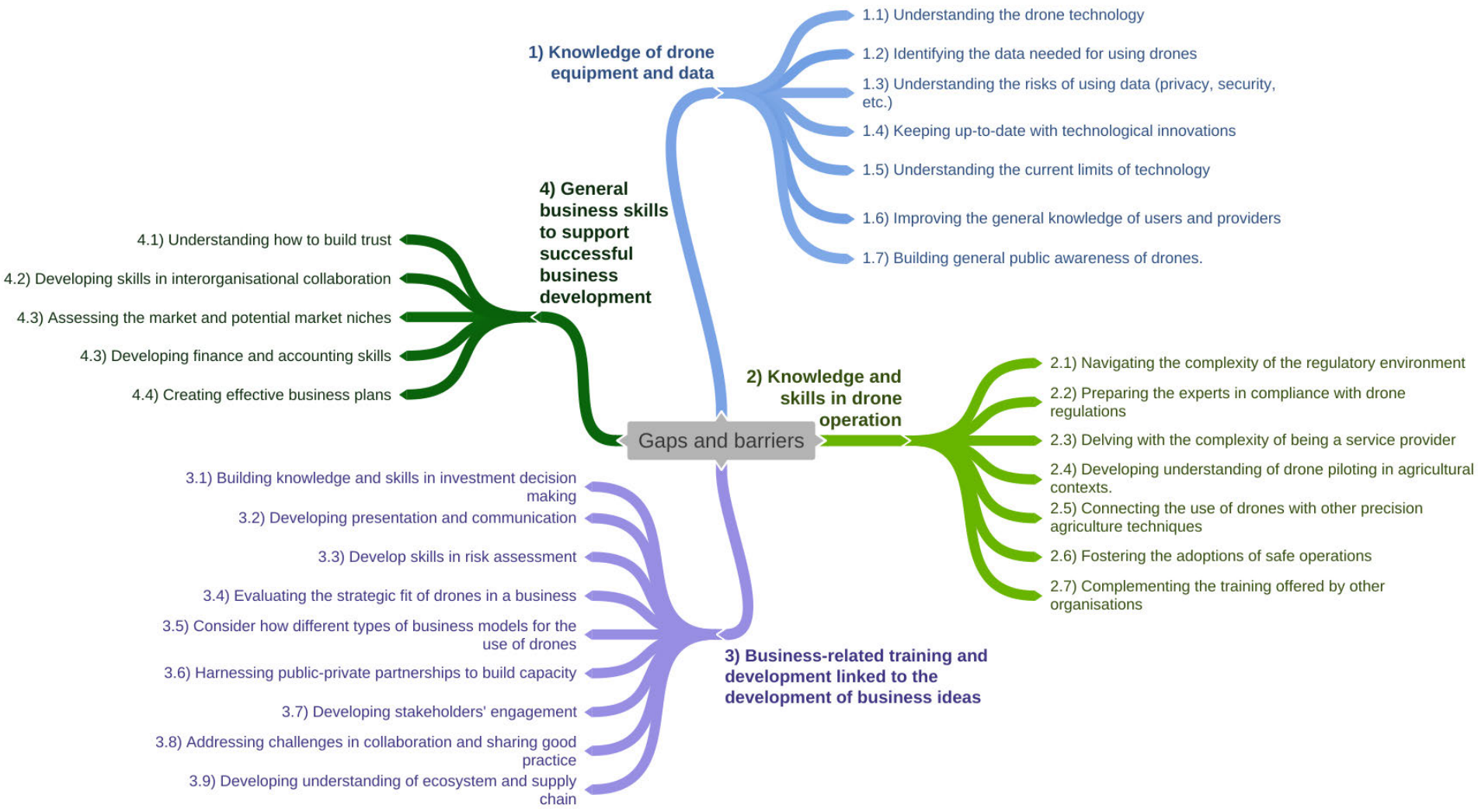

Figure 8: Gaps and Barriers in Knowledge and Skills

4.1.1 Alignment of Results with the ICAERUS Drone Landscape Analysis

The findings strongly align with the results of the market and stakeholder analyses performed in ICAERUS's Work Package 1. The focus group discussions highlighted how training and education could support the development of a 'value-creating system' – building an ecosystem through key stakeholder engagement (D1.1 European Landscape of Drone Innovations and Technologies HE ICAERUS Project[2], p.10). The business models emerging from the focus group discussions echo the different market value propositions examined for each of the use case contexts.

For example, the market analysis for Use Case 1 links a service business model to addressing issues of quality, market competitiveness and climate monitoring and mitigation within the Catalonian wine industry (D1.1, p. 42). In this context, a value proposition is closely aligned to addressing key needs of agricultural customers (vineyard owners) in terms of ensuring quality and, hence, productivity and profitability. Here, business skills in analysing market niche and responding to customer needs is a primary aspect of creating a successful value proposition. A similar link to education and training on identifying market niche was an important aspect of Use Case 3 (Livestock Monitoring in France).

In Use Case 4, on the other hand, a B2B business model based on public-private partnerships is the focus within the Lithuanian forestry sector to use drone technology to monitor the health of forests maintained by state-owned enterprises as well as private firms and other related stakeholders. With this business model, stakeholder management skills (i.e., collaboration skills), as well as a deep understanding of sector need defined by the regulatory environment (e.g., regional and EU forestry strategies) will be crucial aspects of training and development (D1.1, p. 71).

Similarly, the results of the focus groups align with findings of the 'bottom up' stakeholder analyses for each of the Use Cases, such as the importance of identifying a value proposition or propositions in each case and determining the 'value flows' of the different partners (D1.1, p. 128). The stakeholder analyses highlight the complex network environments of the regional sectors of the Use Cases. For example, value flows within the stakeholder network of Use Case 5 (rural logistics in North Macedonia and surrounding regions) illustrate the need for developing an understanding of the many B2B and B2C relationships within the network and how end-users (e.g., those requesting and receiving deliveries) will need to 'prepare and co-work with the rest of the network on a more frequent basis' (p. 128). In light of this, it is crucial to understand how actors / stakeholders interact to co-create and deliver value. It is also important to consider and understand the interdependencies across these actors and both cooperation and competition dynamics in these business ecosystems. Insights from platforms and the ecosystem literature can be useful in broadening this kind of understanding.

4.2 Implications for Training and Development

These network complexities illustrate two important features to include in training and development materials. First, as noted in the D1.1 (pp.13-14), such complexity is a feature of early growth in technological ecosystems, and businesses may not easily identify their role in the ecosystem until later in the sector's growth process. Thus, while there may be several areas of training and development required across the ecosystem and its constituent parts, training can be focused on assisting businesses (and entrepreneurs entering the field) in identifying how they can provide added value and in developing a robust business case.

Secondly, despite the heterogeneity of the focus groups and their stakeholder representatives across the different Use Cases, important common elements of training have been identified, regardless of context.

[2] Bojkova, V. (2023), D1.1 European Landscape of Drone Innovations and Technologies, WP1 Drone Landscape Analysis, HE ICAERUS Project, 2023. Referenced here as D1.1.

Although applicable business models may differ depending on context, training can best support new entrants (and development of existing businesses) by offering a common framework in which identify the value proposition, the possible partners and stakeholders in the network (and how best to work with them), the investment needed, and communicating these effectively to the network. As such, the training programme outlined in the Syllabus in Section 5, below, aims to support the development of business cases for entry into market. Such cases can be made by stakeholders across the range of the ecosystem, regardless of their role within the system. Therefore, the Syllabus also aims to align with the both the Push and Pull Calls of the ICAERUS project, which requires applicants to demonstrate an understanding of stakeholders and the potential market, to articulate clearly the business model and value proposition they are proposing, to show how investment will be used, and to identify what impact they expect and how they will measure it (e.g., via KPIs).

4.3 Analysis of existing courses

Our analysis of existing courses identified three different categories of learning focus. **Technical** courses make up a majority of available courses, which are intended to provide information related to the use drones including their piloting and the use of data collected from drones. An example of this type of course is the one offered by 'ClassCentral' (reported in the first line of Table 9, below). Technical courses are mainly constituted of a series of videos, which can be offered through a platform or on YouTube. Another technical course is the one offered by Wageningen University: (see the second line of Table 9): its aim is to develop piloting skills.

Table 9. List of online courses on the use of drones

Course Provider	Platform	Title	Link (18/06/2023)	Cost (18/06/2023)	Type
Augmented Startups	ClassCentral	AI Drone Tutorials	*AI Drone Tutorials > I Built an AI Controlled Drone (1/3) | Class Central Classroom*	Free	Technical
Wageningen University	Edx	MOOC Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	*MOOC Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission - WUR*	Free on Edx, Cost per certificate: 154€	Technical
The Institute for Drone Technology	Future Learn	Drone Safety for Managers	*Drone Safety for Managers in the UK - Online Course - FutureLearn*	Free on Future Learn, Cost per certificate: 89£	Safety and Legal
SPH Engineering	Proprietary platform	Introductory course: How to start your drone show business	*Introductory course: How to start your drone show business — Shop | SPH Engineering (ugcs.com)*	149€ + VAT	Business
PilotInstitute	Proprietary platform	Drone Business Made Easy	*Drone Business Made Easy Course: How to Start - Pilot Institute*	79$ + VAT	Business
UAVHUB	Proprietary platform	How to Build a Successful Drone Business -	*How to Build a Successful Drone Business -*	249£	Business

		Marketing & Sales Training Course	*Marketing & Sales Training Course | Drone Courses (uavhub.com)*		
DroneU	Proprietary platform	Drone Business Get Started	*Get Started - Drone U™ (thedroneu.com)*	57$ per month, 527$ annual subscription	Business
DARTdrones	Proprietary platform	Start a Drone Business with DARTdrones	*Starting a Drone Business Course - DARTdrones*	30$	Business

A second type of course sits at the crossroads of technical and **legal** subjects. For example, a series of short courses were developed for FutureLearn by The Institute for Drone Technology, which focus on the safety and legal aspects of using drones. The link reported in Table 9 is related to the UK context, but there are other versions addressing legal issues in other countries and which consider different norms. Besides legal aspects covering drone operation, these courses also consider safety issues, risk assessment and risk management (e.g., incident reporting).

The last group of courses is the most relevant to this project because it relates to the development of **business** applications of drones. Some courses adopt the format of video recorded lectures (e.g., those offered by PilotInstitute, UAVHUB), whereas others make use of a combination of text- and video-based information.

The length of courses varies between very short courses (e.g., SPH Engineering) which is a 6-hour course dedicated to launching a drone show business, to longer courses covering a larger number of topics. It is interesting to note that all courses in this group provide background on business strategy, such as the definition of a business vision or purpose ("your why") and some introductory planning skills. These are often complemented with digital marketing knowledge, as well as how to promote a business online (see PilotInstitute, UAVHUB). DARTDrones' course also includes business operations, legal aspects and drone insurance details.

A common feature of these business application courses is their strong emphasis on the experience of the course creator (e.g., Chris Speicher of DARTDrones) with some courses offered via proprietary platforms, or they reference consulting approaches such as the Kolbe test in the DroneU course. OpenLearn courses are influenced by the Open University's distance and online pedagogical model, which adopts a pedagogy based on asynchronous, self-directed learning offered through hypertext and graphical (e.g., images, diagrams and charts) and video contents, as well as interactive activities to keep the learner engaged. OpenLearn courses are free and open access and draw on knowledge and evidence from a wide range of scientific and academic sources, similar to courses found in higher education settings.

While preserving its academic outlook, the ICAERUS OpenLearn course will make use of the practical and professional experiences from the field of drone operators and the Use Case Partners, while also complementing existing courses and local stakeholder and expert knowledge available through the existing courses, such as the FutureLearn course on legal and safety aspects or Wageningen University's course on preparing and designing drones for agricultural uses.

4.4 Levels of Understanding and Formulating a Value Proposition

The focus groups illustrated a wide range of levels of understanding of the field with focus groups including stakeholders coming from across the regional networks (as seen in Table 1, above), including end-users, service providers and software designers, drone manufacturers, representatives from regional associations, academic institutions and public regulatory bodies, and representatives of related industries,

among others. With such a broad range of stakeholders, the levels of understanding are necessarily varied. Some stakeholders are knowledgeable of the regulatory environment and less so of, for example, drone software. Other stakeholders are knowledgeable of precision agriculture techniques while others are skilled drone pilots.

As noted earlier, the analysis of the focus group data emphasised the need for training to focus on development of robust business cases, including identifying the strategic fit of drones within agricultural, rural and forestry businesses. An important part of determining strategic fit, i.e., the business model proposed, is to identify the value added to the customer. This is a challenging aspect of developing a business case – especially when customers or end-users may have a low level of understanding of benefits, risks and challenges.

4.4.1 Value Propositions for End-Users

Focus group participants acknowledged that currently there is a low level of existing understanding of the use of drones in agricultural, rural and forestry sectors by end users. This refers to all specific applications that the Use Cases focus on. There is low level of knowledge on operating drones and using them in carrying out agricultural activities. Moreover, it was acknowledged that this low level of understanding could lead to misuse, and that avoiding misuse can alleviate concerns and mistrust in the surrounding technology.

The Use Case demonstration stage aims to assist with building a greater understanding of the benefits and safe use of drones in the Use Case environments. Similarly, demonstrations and wider training within the respective Use Case sectors can reduce user uncertainty in choosing the right drone hardware or software, or in evaluating potential drone service providers. This is an important set of findings related to the development of a clear value proposition for end users and potential customers.

4.4.2 Capacity-Building in the Wider Ecosystem

At a broader ecosystem level, capacity-building can aim to develop an understanding of how new drone businesses (i.e., service providers) can contribute to Agriculture 4.0[3] 'From Farm to Fork' (Appelqvist et al., 2022), which is currently in its infancy. This includes developing knowledge of how to capture, analyse and use data generated from drone applications and feeding these into knowledge transfer initiatives. Developing a key knowledge transfer platform is an important feature of the wider ICAERUS project, which will enable capacity building across the ecosystem.

It is noteworthy that some of the focus groups brought together participants and stakeholders with substantial knowledge of drone manufacturing, operation and related digital technologies and software (e.g., companies that develop mobile applications to remotely control drones). Some of these stakeholders represented associations that consult on export strategies and shape the legal framework at European level. Other stakeholders combined expertise across a range of digital technologies (e.g. 3D lasers, scanning and combination with virtual environments) or carried experience in related fields such as satellite systems. Participants with experience in military applications of drones are exploring the use of hyperspectral cameras in agriculture and forestry. It is noteworthy that these participants are residing in a context that is advanced in digital applications and solutions at the city/country level and thus can provide important knowledge transfer opportunities to the broader ecosystem.

[3] Agriculture 4.0 refers to the use of Internet of Things (IoT), Big Data, Artificial Intelligence and Robotics to extend, speed up, and increase the efficiency of activities that affect the entire production chain (McCormick, 2021). One can recognise the parallels with Industry 4.0. The aims of adopting 4.0 solutions in agriculture are: a) avoiding unnecessary waste, b) having greater control over cost and being able to plan all stages of cultivation with a great deal of precision, c) improving the traceability of the supply chain (ibid.).

5. Syllabus and learning needs

5.1 Introduction of personas for tailored training

The Personas described in Tables 10 and 11 represent seven key stakeholders for the online training course. During the learning design workshop, participants considered the dimensions of knowledge that would be needed, along with each persona's motivation to engage with the teaching materials.

Table 10. Personas 1, 2 and 3

	Persona 1 Michael	**Persona 2** Sarah	**Persona 3** Pam
Description:	Member of a private company working with drones	Advisor (agronomist), for farmers	Policymakers
Knowledge about **drone applications**	Good	Limited	Limited
Knowledge about **business ideas development**	Already working with drones (with SMEs)	Limited knowledge of the entrepreneurial frameworks, more on financials	Medium
Why to study this course?	Developing business knowledge. Understanding market, regulations, etc.	Interest in using drones: e.g., discovering the benefits for plant protection. Interested in the impact of drones on farming activities	Developing an understanding of the possible business models related to drones and how to support them

Table 11. Personas 4-7

	Persona 4 Paul and Martina	**Persona 5** Claire	**Persona 6:** Jo	**Persona 7** Simon and Nadine
Description:	Family business owner (wine producer) and owners of land and a small forest	Representative of a collective of farmers (association):	Researcher linked to university and a local government programmes	Manager of a company developing crop protection (for spraying drones) and owner of transportation companies for logistical services.
Knowledge about **drone applications**	Limited	Limited	Medium/high	Medium
Knowledge about **business ideas development**	Medium/high	Experienced in investment	Low	Good
Why to study this course?	Evaluating what business applications or services based on drones can be introduced in their company	Considering the funding issue of financing the investment in tech Developing support initiatives for drone applications.	Developing knowledge on the subject to enable local diffusion (e.g., courses for farmers in local institutions)	Become possible service providers

5.2 Learning outcomes of the course

Open Learn courses typically have five learning outcomes. These have been developed to cover 'Knowledge and understanding', 'Cognitive skills' (e.g., transferable skills), and 'Practical and professional skills' related to the development of a business venture.

Knowledge and understanding

LO1. Developing knowledge and understanding on the drone industry and the emerging innovations-in the sector

LO2. Developing knowledge and understanding on different business models for the use of drones.

Cognitive skills

LO3. Identifying and collecting relevant information to develop evidence to support the development of a new business idea

Practical and professional skills

LO4. Evaluating the economic, social and environmental impact of new business idea, considering its sustainability.

LO5. Articulating and communicating professionally a new business idea to different stakeholders

5.3 Delineation of what is taught and what is not, reasoned choices

Each of the phases of the learning design process has helped to refine the aims of the course, its learning outcomes, and the potential students (as articulated in the personas). The themes emerging from the focus groups point to a comprehensive set of learning needs spanning general awareness of the public and end

users of technical skills in piloting drones, an understanding of the wider ecosystem and regulatory environment, as well as business knowledge and skills to create a viable value proposition.

The course is limited in scope by its duration (24 hours over 8 weeks), as well as challenges in accurately addressing issues across multiple European regions and differences across sectors. However, the focus group data indicate a strong need for training and support in developing business ideas, such as those proposed by applicants to the ICAERUS Push and Pull Calls. Therefore, the proposed syllabus, detailed below, aims to provide learners with a set of knowledge and skills they can use to develop a robust value proposition and/or business proposal. The course design also supports engagement of learners who may have an interest in supporting those who wish to develop a drone business, or those who want to learn more about the use of drones in agricultural, forestry and rural contexts. Optimally, the course will allow learners from a variety of regions and contexts to engage with and harness their existing networks and ecosystems.

5.4 Syllabus

The Syllabus of the Open Learn Course is articulated in eight weeks of study of about 5.000 words of equivalent student workload, with two points of assessment. The following sub-sections describe the content of each week articulated according to a cycle of learning that starts from contents (***Subjects***) linked to the development of ***Skills***. Use Cases are used as ***Examples*** to facilitate the development of the skills by providing models that learners can look at and replicate. At the end of each week, learners will be invited to develop specific ***Outputs*** in order to apply the content and test their skills in practical ways. The elements mentioned before – Subjects, Skills, Examples and Outputs – are presented for each week of study with the aim of creating an experiential learning cycle (Kolb, 2015): for example, Week 4 concentrates on the concept of the *value proposition* and develops skills related to the identification and design of a value proposition for a new business idea using drones. The work in Week 4 is illustrated using the Rural Delivery Use Case. The output learners are invited to develop in Week 4 is a value proposition for a new business idea.

5.4.1 Week 1 – Introduction to the drone business

The introductory Week of the course will showcase the course content presenting the market opportunities as well as the evolution of the industry. The aim of the week is to engage learners in the course content presenting the potential of business development in the drone industry. Recent literature developments have already been discussed in WP1 D.1.1 Drone Landscape Analysis. Additional market analysis will be included in WP1 D1.2 Comparative Analysis and Needs Report. Recent literature developments (Agarwal et al., 2021; Moeen et al., 2020, 2020; Shermon & Moeen, 2022) will be coupled with the latest industry data available on the worldwide drone industry ('MarketLine Industry Profile', 2022). Strategic management literature will support the development of the contents related to industry lifecycles (Giarratana, 2013; Grant, 2018; Lynch, 2015).

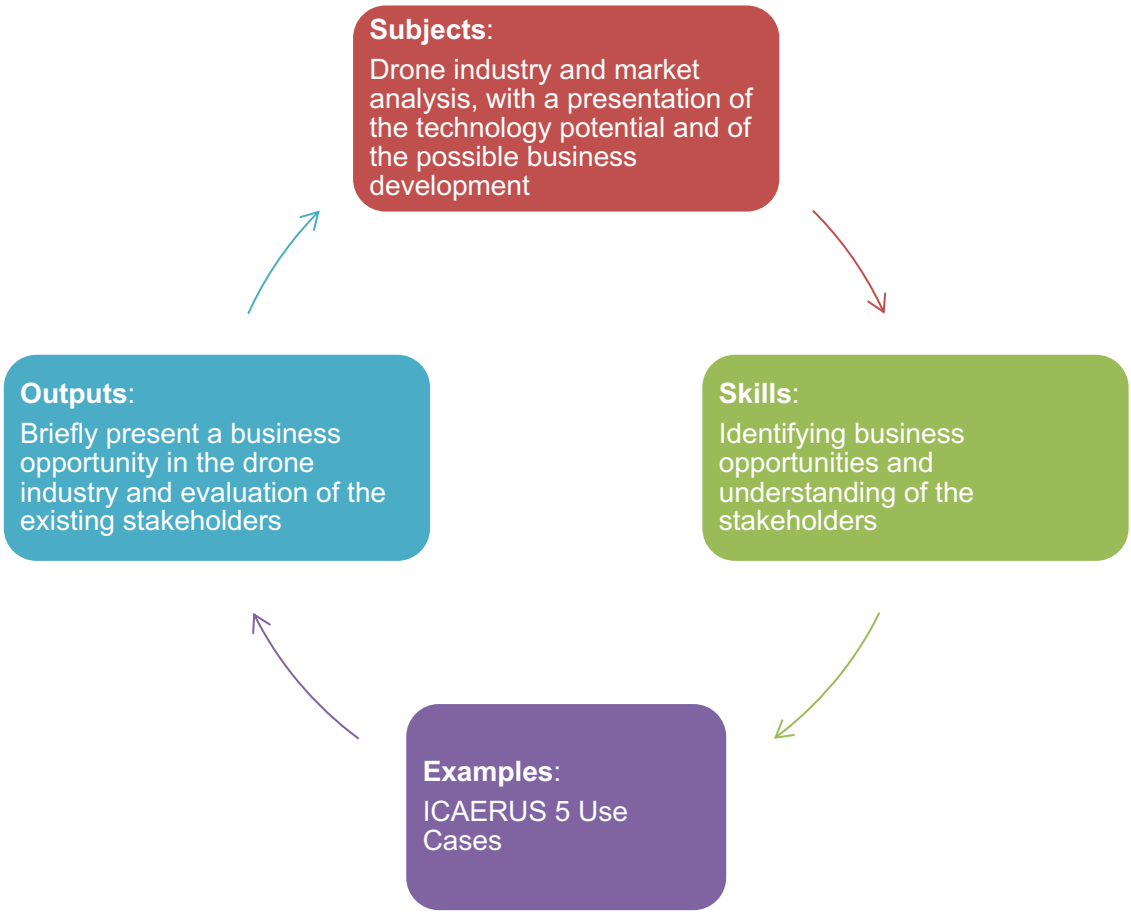

Figure 9: Syllabus Week 1

5.4.2 Week 2 – Business models types and their application in the drone industry

The Business Model concept is introduced in this week referring to foundational literature (Baden-Fuller & Morgan, 2010; Zott et al., 2011) and recent developments (Cozzolino et al., 2021; Cutolo et al., 2021; Massa et al., 2017). An initial categorisation of different business models with examples for each business model types will be offered distinguishing dyadic business model based on the exchange of value between two parties and triadic business models based on the presence of a platform (Baden-Fuller et al., 2018). A connection with the *Business Model Zoo* will provide a further possibility to expand the understanding of business model types. A more detailed discussion of business model patterns will also consider the distinction between product and service -based business model and include sustainability as a central aspect (Lüdeke-Freund et al., 2022). This week will enable learners to distinguish business models of existing companies and to start considering how to model the business model of a new venture.

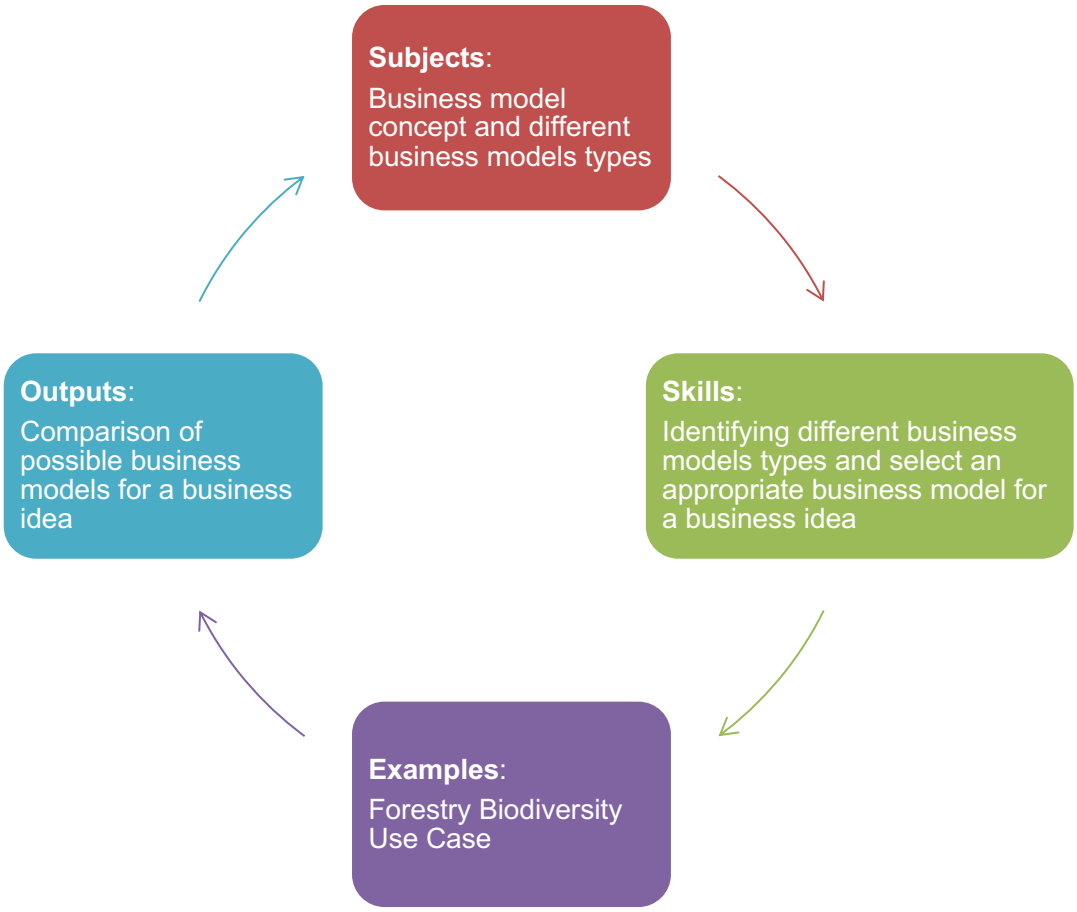

Figure 10: Syllabus Week 2

5.4.3 Week 3 – Regulations and data surrounding drones

This week will be predominantly dedicated to two aspects: the regulatory environment and the use of data related to drones. The main sources of this week will be internal to the project and respectively Deliverable 1.3 - Drone Standards, Regulations and Risks and the Deliverables related to Work Package 2: Deliverable 2.1 - ICAERUS Drone Data Analytics Library and Deliverable 2.2 - Data Analytics Optimisation, Expansion & Scale-up Report (which will be used in the early draft versions for the creation of the course material).

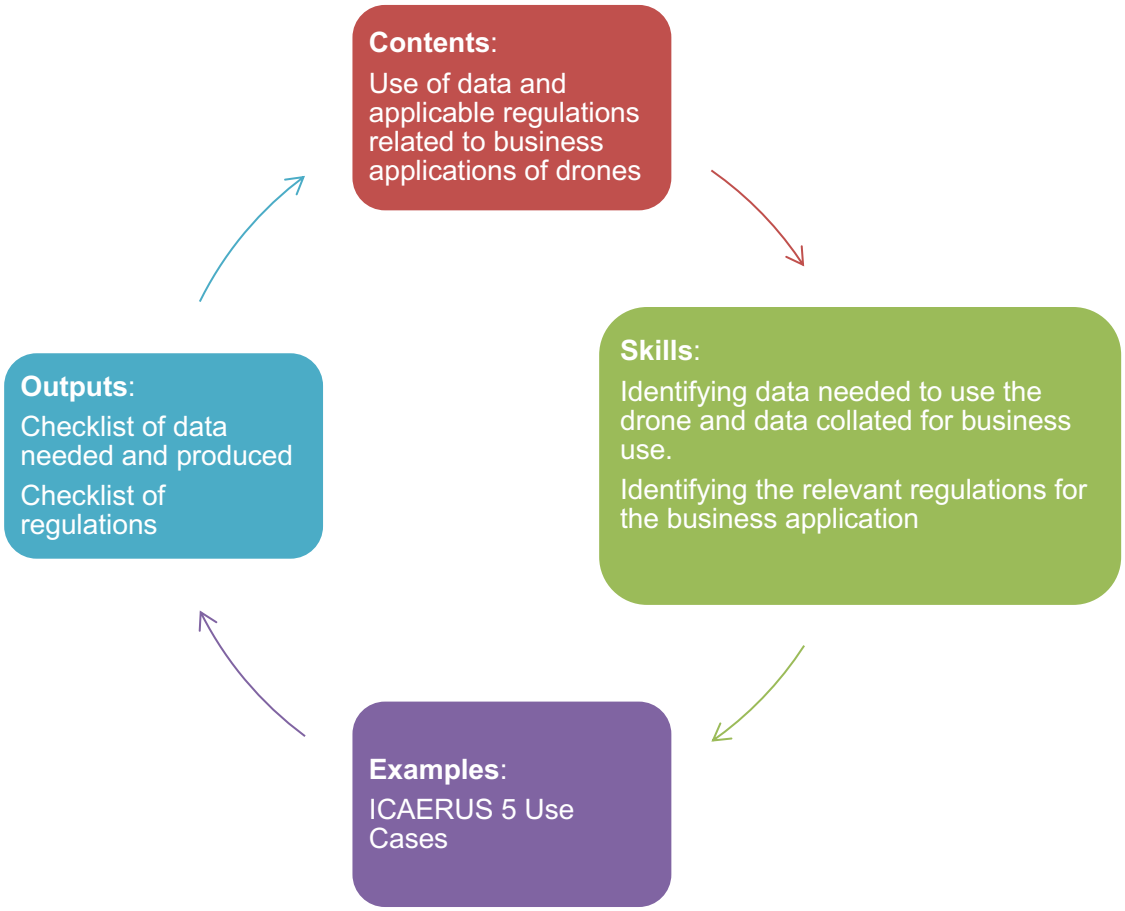

Figure 11: Syllabus Week 3

5.4.4 Week 4 – From new business ideas to value propositions

This week combines the generation of business ideas and their presentation in terms of the design of a value proposition. Elements of entrepreneurship will be introduced to support the learners in reflect in the recognition and seizing of opportunities (Spinelli & Adams, 2015, Chapter 5). These elements will be combined with the recent development of Osterwalder's thinking on business models, which delves into the concept of business ideas (Bland & Osterwalder, 2020) to transform them into working value propositions (McAdam, 2013, Chapter 1; Osterwalder et al., 2014). Examples of a possible application of the concepts based on the Rural Logistics use case will be offered using a series of videos to exemplify the design work, and learners will be provided with templates. This week will end with a quiz as first part of the assessment.

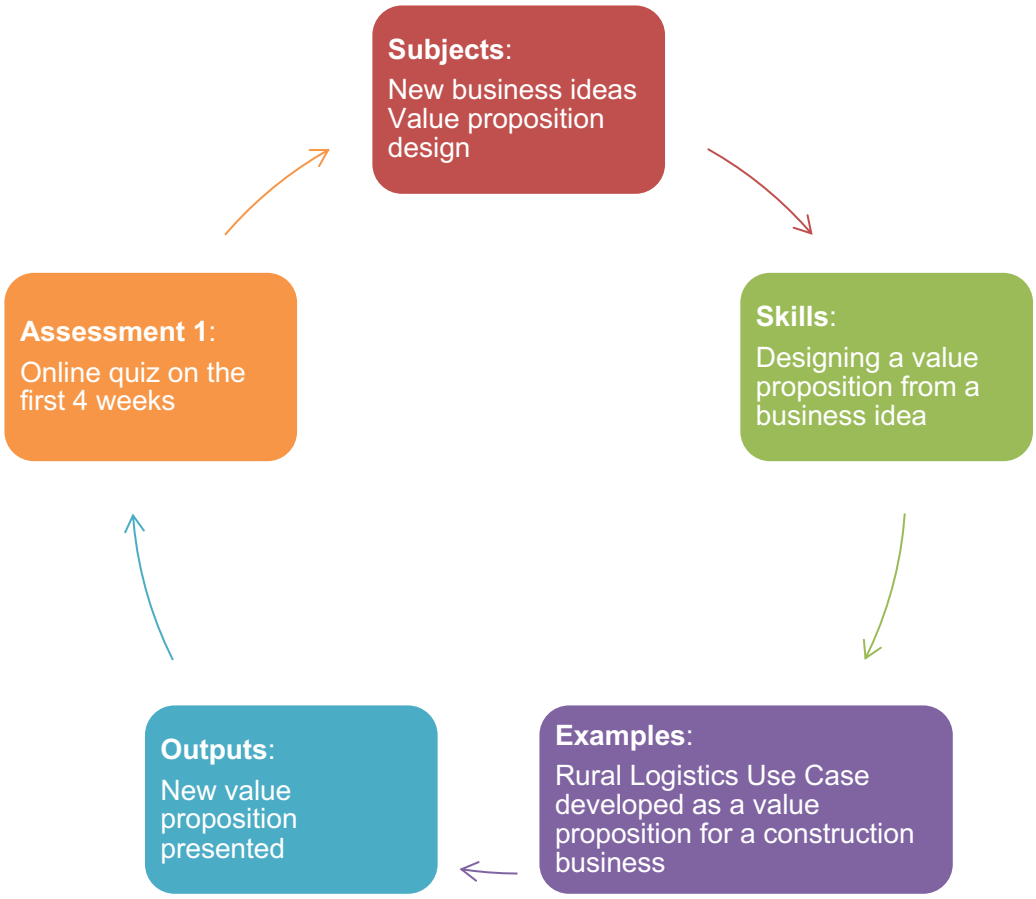

Figure 12: Syllabus Week 4

5.4.5 Week 5 – Designing a business model for a new business idea (Part 1/2)

This week is the first of two weeks dedicated to the design of a new business idea and its development using the popular tool, *Business Model Canvas* (Osterwalder et al., 2010). The idea behind the week is to familiarise learners to the business model canvas tool as a way to make them reflect on several fundamental aspects of their new venture: the first week dedicated to the business model canvas will concentrate on Customer Segments, Customer Relationships and Channels, considering also the competitive positioning of their business idea (McAdam, 2013, Chapter 3). The Crop Monitoring Use Case will be used as a model to showcase how to model the canvas.

Figure 13: Syllabus Week 5

5.4.6 Week 6 – Designing a business model for a new business idea (Part 2/2)

This second week on the business model canvas will continue the development of skills related to the internal part of the business model considering Resources, Activities and Partnerships (Osterwalder et al., 2010). Collaboration was considered fundamental by focus group participants and partnerships will play a critical role in the design of business models related to drones. In addition, evaluations of revenues and costs will be introduce to support learners in drafting a financial plan (McAdam, 2013, Chapter 5). The Livestock Monitoring Use Case will be used to showcase a possible design of a business model canvas.

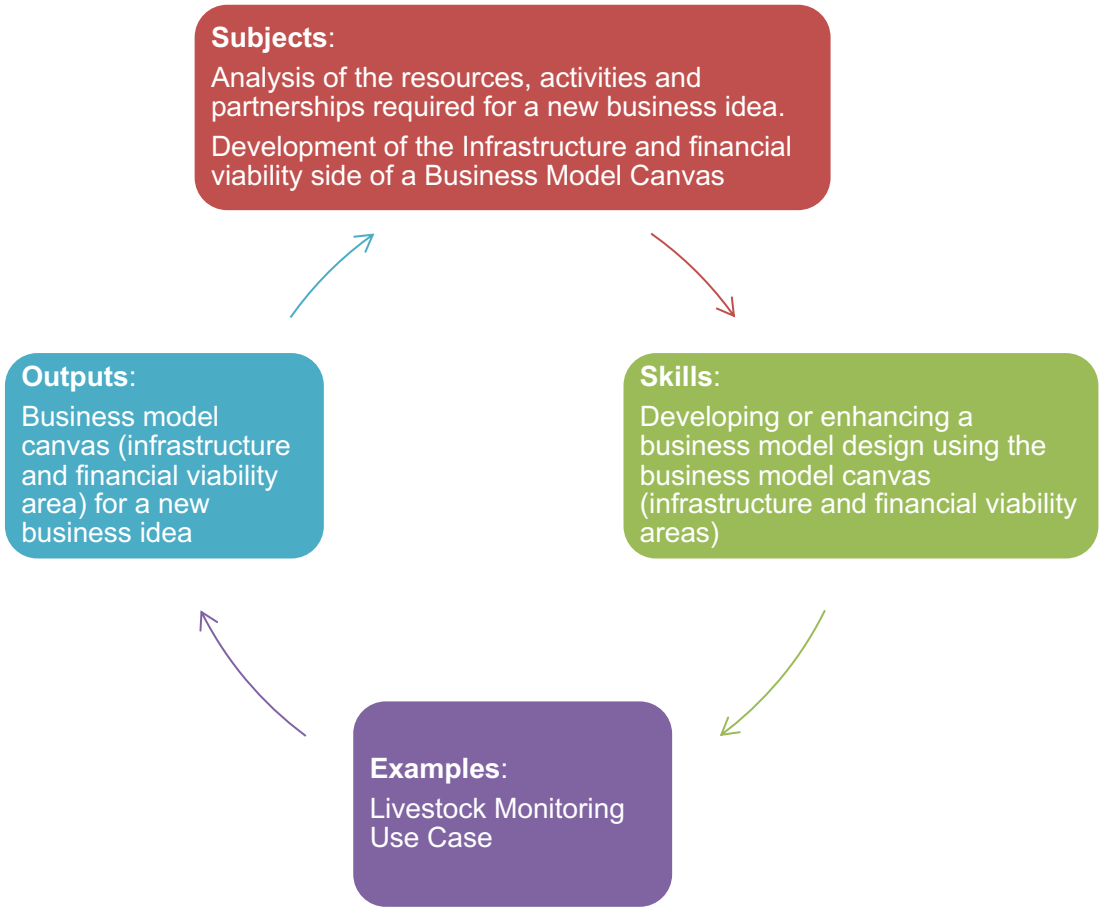

Figure 14: Syllabus Week 6

5.4.7 Week 7 – Business ecosystems and the sustainability and risk of a business idea

The positioning of a business model idea in an ecosystem will lead to the fundamental reflection on how value will be created and who will capture it in the interplay between the actors in the ecosystem. Whereas the ecosystem literature is in development (Cozzolino et al., 2021; Jacobides et al., 2018), the consolidation of platforms enable the development of an understanding of the distribution of value and the possible role of public institutions (Mazzucato, 2015, 2018). The systemic reflection will then translate in the evaluation of the lifecycle sustainability of the business model considering the preliminary results of the lifecycle analysis (Task 3.3), referring specifically to the Drone Spraying Use Case, and the literature related to the analysis of risks of new projects (Meredith & Mantel, 2012, Chapter 6).

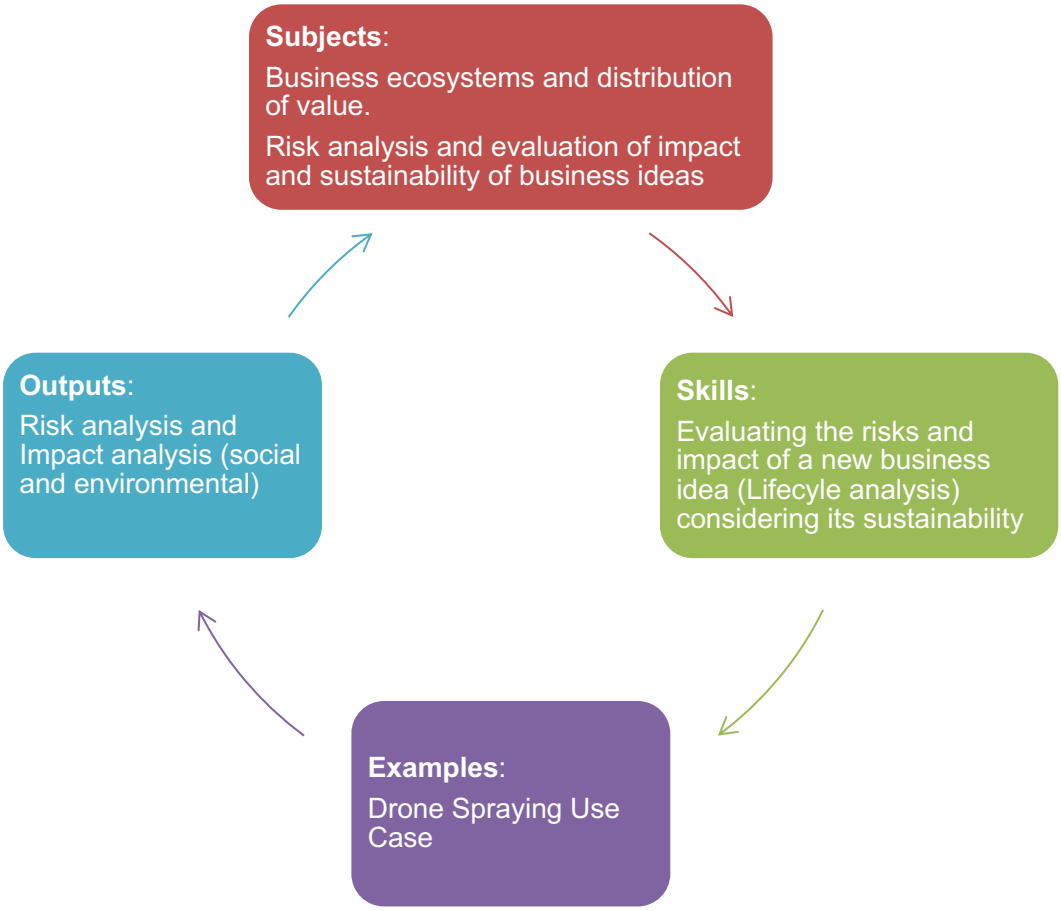

Figure 15: Syllabus Week 7

5.4.8 Week 8 – Presenting a new business idea to stakeholders

This last week will conclude the course by concentrating on *soft* skills related to the ability of interacting and working with stakeholders. Pitching a business ideas could be challenging and the suggestion from literature (Charantimath, 2018, Chapter 7) will be combined with the experience of project partners and use case representatives in several video interviews and the initial results of the ICAERUS socio-economic adoption study (Task 3.3). The week will conclude with the second assessment of the course.

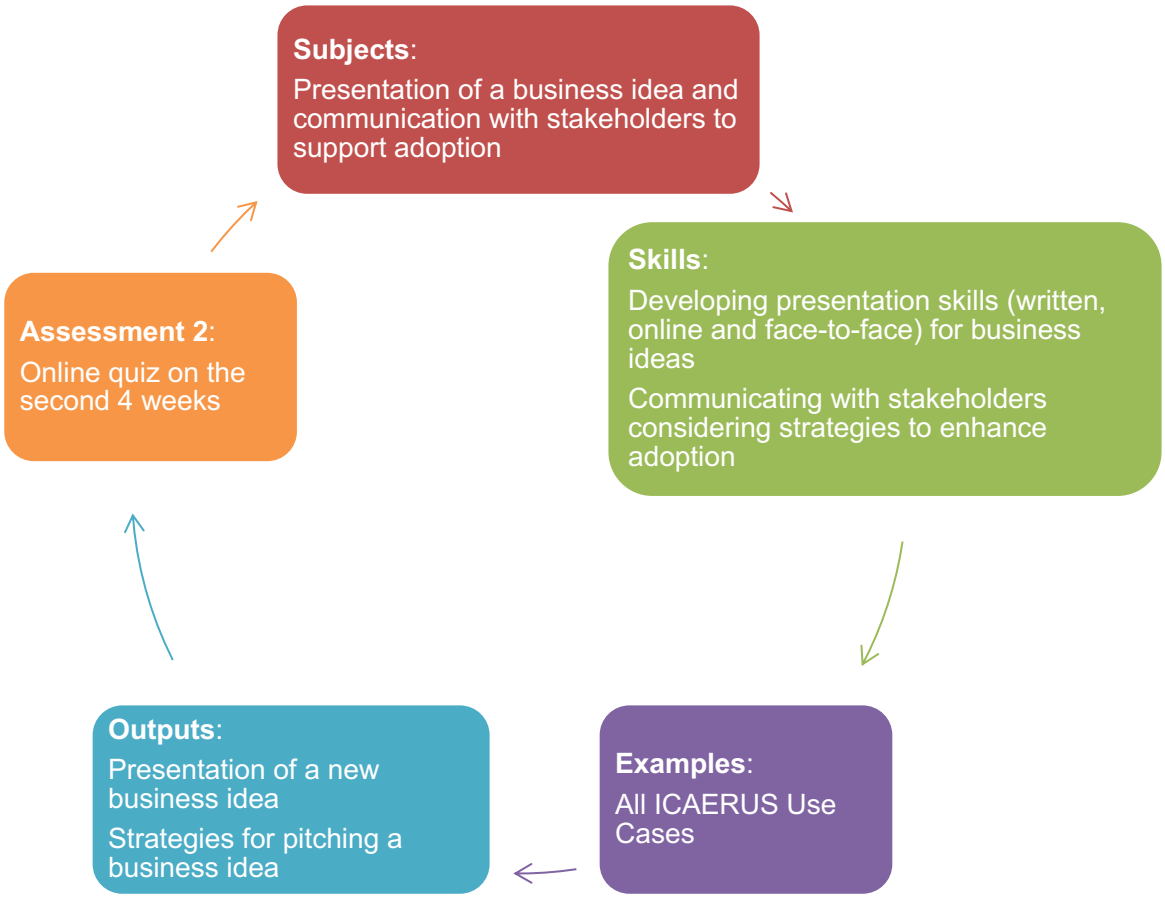

Figure 16: Syllabus Week 8

5.5 Assessment and certification

The assessment of the course content and the development of skills reflect the course's online, open and free access nature. The assessment of contents will be conducted though quizzes, whereas learners will be engaged in formative activities to develop output such as presentations or completing templates in each week.

At the end of Weeks 1–3 and 5–7 learners have the option of completing a 5-question practice formative quiz. These quizzes do not contribute to the learner passing the course. At the end of Weeks 4 and 8 there are 15-question compulsory quizzes. Learners must achieve 50% or higher in both quizzes to pass the course. They can attempt the quizzes more than once.

Figure 17: OpenLearn CPD Accreditation

The statement of participation, obtained after a successful completion of the assessment, will be accredited by the *Continuing Professional Development Standards Office* in the UK with 24 CPD points (see accreditation number in Figure 17). The Open University Team is also willing to accredit the course with the equivalent European institution.

6. Conclusions

6.1 Summary of key findings

The ICAERUS project aims to empower stakeholders with the necessary knowledge and skills to effectively apply drone technology in agriculture, forestry, and rural sectors through education, training, and valuable resources.

One of the key components of the ICAERUS project is the establishment of the ICAERUS Academy, which will serve as a central hub for education and training across the regional and European ecosystem. A significant aspect of the educational program is a 24-hour free online course, accessible to all, that enhances the capacities of local stakeholders to implement technological innovations in their specific contexts. The course focuses on helping stakeholders develop viable business models and value propositions, using the Use Cases as examples. Please see section 6.2 Implications, for a summary of the course.

The report outlined the initial stage of course development, presenting an indicative syllabus, its assessment approach, and certification criteria. The course's design process involved participatory methods, including focus groups conducted in the Use Case contexts and a learning design workshop. The course will be featured on OpenLearn, the Open University's online platform, and will consist of eight weeks of online learning with two quizzes for certification. The course is expected to launch in early January 2024, initially in English but with plans for translation to increase accessibility.

The methodology applied to develop the syllabus followed an iterative approach starting with seven focus groups conducted in the use case countries and in Italy, complemented with the analysis of the results of the landscape analysis from Work Package 1, the comparison of existing online courses and the learning design workshop.

The focus groups aimed to identify gaps, barriers, potential partnerships, and learning needs related to the sector's development. The focus group analysis revealed four main areas of learning connected to the issues discussed by participants. These areas include knowledge of drone equipment and data, skills in drone operation, business-related training for developing business ideas, and general business skills for successful business development.

While some focus groups identified specific business-related training requirements, many of the emerging needs were linked to the challenges and barriers mentioned by participants, and these are represented in Figure 8 as Learning Gaps. For instance, knowledge and skills in collaboration, building trust with community stakeholders, and establishing successful inter-organizational partnerships were identified as areas that could support engagement with different stakeholders in the sector.

The analysis conducted on stakeholders in Work Package 1 resonated with the focus group discussions highlighting the importance of training and education in supporting the development of a value-creating system and building an ecosystem through stakeholder engagement. Participants emphasised the connection between specific business models and market value propositions identified in different use case contexts. Stakeholder management skills and understanding the regulatory environment were highlighted as important for training and development across the sectors. Training should address the complexities of business ecosystems, help businesses identify their roles, and assist in the development of robust business cases.

Finally, the analysis of existing courses showed that, while training on the technical operations of drones is largely accessible and available, there is a much more limited offering on the legal aspects of the sector

and on business development. In this panorama, the positioning of a free, open access course aiming to build business-related knowledge and skills would be attractive and beneficial for local and regional stakeholders and can offer additional value in offering training and education underpinned by academic knowledge and practical skill development.

6.2 Implications

The indicative syllabus presented in Section 5 covers 24 hours of learning across 8 weeks addressing five key learning outcomes for knowledge and understanding, cognitive (transferable) skills, and practical and professional skills. These aim to assist learners with the knowledge and skills to develop a business idea and identify a viable value proposition for drone usage in European agricultural, rural and forestry sectors. The design of the course also aims to provide learners with practical outputs they can use to develop a case, and it will be certified through the CPD Standards Office (in the UK) as well as, potentially, a European equivalent organisation.

An important implication of this work package's research is a set of proposed 'personas' or learners who we can expect to benefit from the course (see Tables 10 and 11). While the course does aim to develop business skills (e.g., in order to develop a business case) the course should also aim to provide a minimum level of general information about these uses of drones (aided by the examples of the use cases) so that the general public and end users can be better informed about the benefits of these types of innovations. Additionally, the course can provide essential foundational knowledge for other stakeholders in the local networks and broader ecosystem, such as those who might consider investing in or partnering with service providers or those who wish to advise end users about the innovations.

A second important implication of the research is that there are common learning needs across the different use case contexts – across different sectors/uses, regulatory contexts and geographic regions. This further supports the aim of this work package and, more generally, the approach being taken by the ICAERUS project as a whole to build capacity across the ecosystem. The course will be a valuable addition to the resources of the ICAERUS Academy.

A final implication of the research is that it offers confirmation and aligns with the results of Work Package 1's landscape analysis – both in terms of the perceptions of the stakeholders mapped as well as the markets analysed – and it complements the landscape analysis with a greater understanding of the learning needs of the stakeholders in the ecosystem.

6.3 Next steps

The current Syllabus is the first step towards the complete design and writing of the open access course. The next steps are listed below, divided into different groups of activities:

Collection of materials and collaboration with project partners:

- Collection of materials (information, videos and images) from each use case;
- Integration with Work Package 5 for the definition of Business Models.

Design and writing of the course:

- Design of a template for structuring weeks and single sessions of the course;
- Modelling of the initial detailed structure;
- Writing of one week of study as a taster to be released six months before the full course is launched;
- Planning and scripting of the video contents required (e.g.: interviews and videos with drones);
- Development of the remaining seven weeks (following the taster Week 1), including any interactive activities, templates, or other assets, and also inclusive of the assessment.

- Editing of the written materials to be delivered on Open Learn platform.

Video recording:

- Recording of videos (e.g., interviews, demonstrations, etc.) to be integrated in the course;
- Editing of the videos and integration in the online course.

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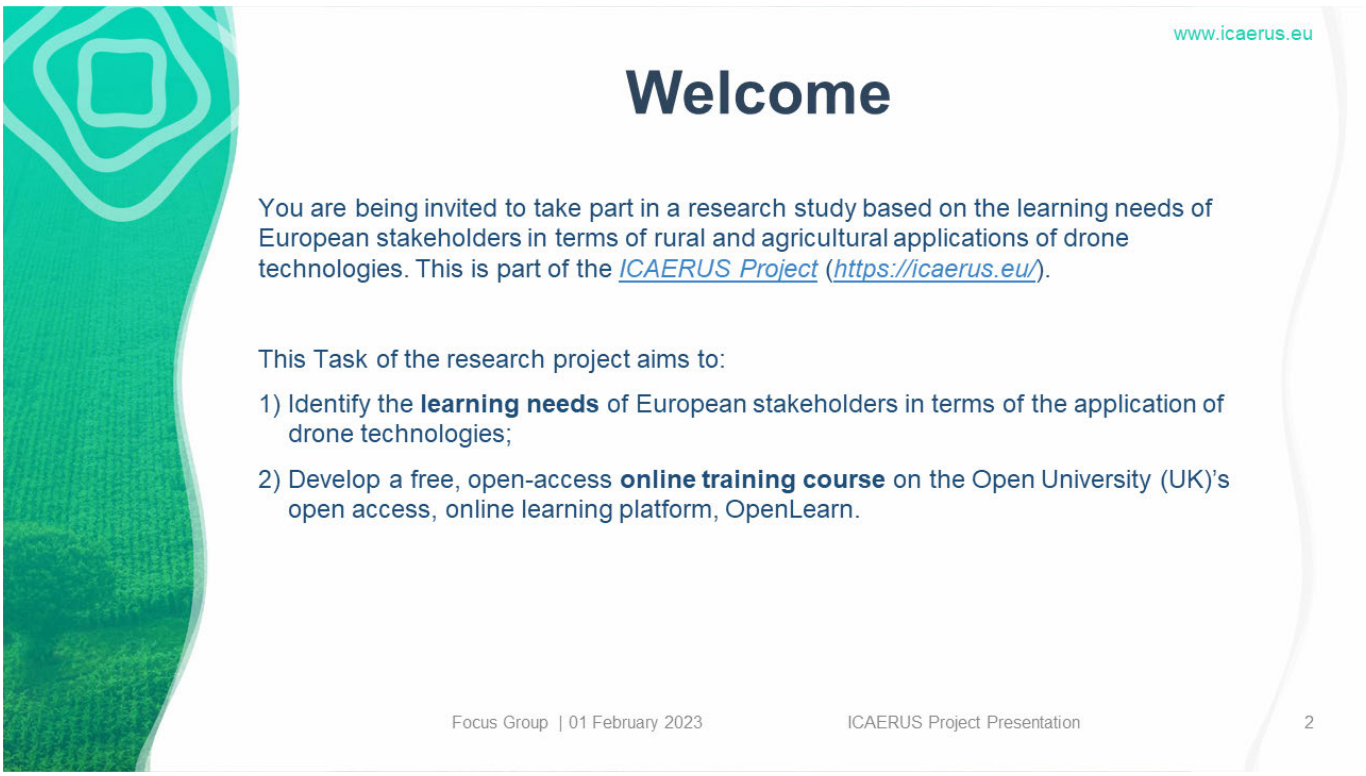
Annexes

Annex I: Focus Group Presentation

The slides prepared for the Fucus Group conducted in Spain are reported below as an example. They include the questions for participants.



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About ICAERUS

Project Information

Title: Innovations and Capacity building in Agricultural Environmental and Rural Uav Services

Proposal number: 101060643

Status: Active

Duration: 4 years **Start Date:** 01 July 2022

Overall Budget: € 5,914,703.00 **Funding:** € 5,458,276.25 - EU contribution & € 465,426.75 - UKRI

Funding scheme: Research and Innovation action **Funded under:** Horizon Europe

Project Officer: Alessandra SASSO **Financial Officer:** Charlotte PONT

Activity: HORIZON-CL6-2021-GOVERNANCE-01-21

Topic: Potential of drones as multi-purpose vehicle – risks and added values

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European Commission's strategies

Drones as multi-purpose vehicle

Drones can make an important **contribution** to a number of **European Commission's strategies** to ensure **food security**, address **climate and environmental challenges** and reverse **biodiversity loss**.

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What challenges are we tackling?

The big picture: Drones are currently used to varying degrees in EU Member States.

The multi-purpose application of drones brings **socio-economic**, **environmental** and **regulatory challenges** that limit their current use across Europe.

- Costly investment
- Knowledge gaps, data protection and technology misuse
- Environmental conditions significantly limit the use of drones
- Regulatory restrictions
- Safety regulations

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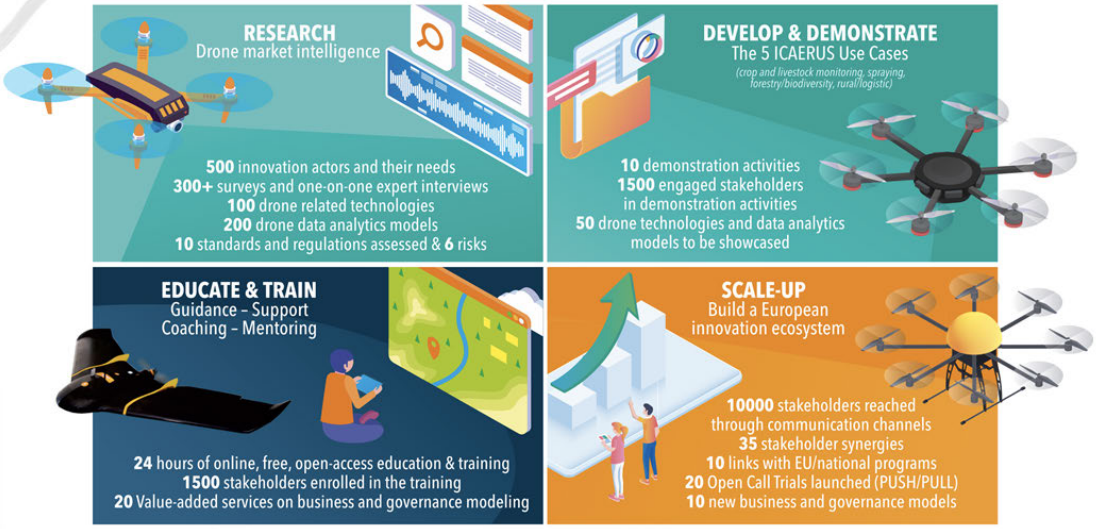
Who we are?

ICAERUS Consortium

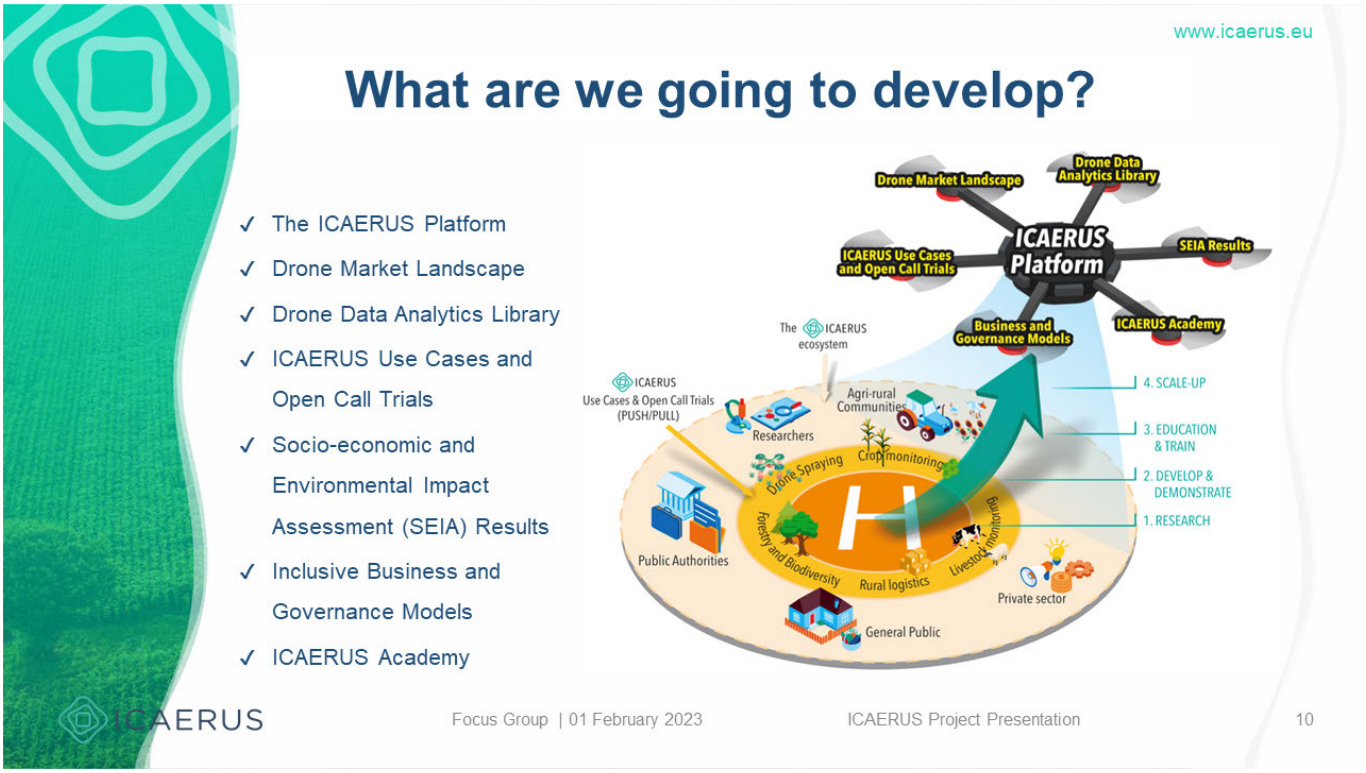
- ✓ 3 European research institutes and universities
- ✓ 6 industry stakeholders and technology SMEs
- ✓ 4 NPOs

ICAERUS Concept & Vision

A game-changer for the use of drones in rural areas



Main Objective



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ICAERUS Use Cases & Open Call Trials

https://icaerus.eu/use-cases/

Focus Group


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Introductions
Let's introduce ourselves!
ICAERUS
Focus Group | 01 February 2023
Questions and Discussion
13


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Part 1
What barriers or challenges prevent market access and use of this technology among farmers?
How can these challenges be addressed?
How can you or your sector contribute to capacity building?
ICAERUS
Focus Group | 01 February 2023
Questions and Discussion
14

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Part 2

What business-related knowledge is needed to use this technology in agriculture business?

What important topics must be known for developing a business using this technology?

Who should be targeted by training to support the business use of this technology?

And what is their initial level of knowledge on the topics you have identified?

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Part 3

What types of partnerships are effective in scaling up technology use?

How can partnerships and public institutions support technology adoption in companies?

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Part 4 - debriefing

Do you have any additional comments or remarks?

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THANK YOU

Giacomo Carli | OU | Giacomo.Carli@open.ac.uk
Aikaterini Kasimati | AUA | akasimati@aua.gr

Annex II: Focus Group Protocol

The slides reported below report the protocol adopted for the focus groups.

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ICAERUS

Innovations and Capacity building in Agricultural Environmental and Rural UAV Services

Task 4.1: Syllabus & Certification

Focus Group Protocol

Project Leader: Giacomo Carli
Senior Researchers: Kristen Reid, Despoina Filiou
Project Manager: Maria Fernandez
Monitoring Officer: John Lee
Project Officer: Helen Sweeney
The Open University

16/01/2023

Funded by the European Union
Grant agreement N° 101060643

1

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Presentation Outline

In this presentation:

- Preparation
- Protocol – see attached presentation for the questions to be used during the focus group
- Debriefing

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Preparation

Before the meeting:

1. Identify the participants and contact them by introducing the topic
2. Get in touch with them: share by email the two forms (information sheet and consent sheet, they can be collected also at the focus group with their signature)
3. Identify a suitable room
4. Prepare the audio recording equipment (a mobile phone would be good: test the audio recording functionality before and put the phone in Fly mode). Do a test before.
5. Prepare a short presentation of the UC technology: slide, video or handout (max 5 mins).
6. Translate the content of the slide in your language and add it to the *ICAERUS_T4.1_Focus Group Presentation* (to be translated in the focus group language)
7. Send a reminder email the day before the focus group (if needed)

On the day:

1. Welcome the participants: invite the participants to arrive before the start so they can informally introduce to each other. (see next slide)
2. Follow the protocol (see next slides)

3

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Participants (internal use only)

Name	Email	Invited (Y/N)	Confirmed participation (Y/N)	Consent form (Y/N)

4

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Questions

Se the presentation named:
ICAERUS_T4.1_Focus Group Presentation

5

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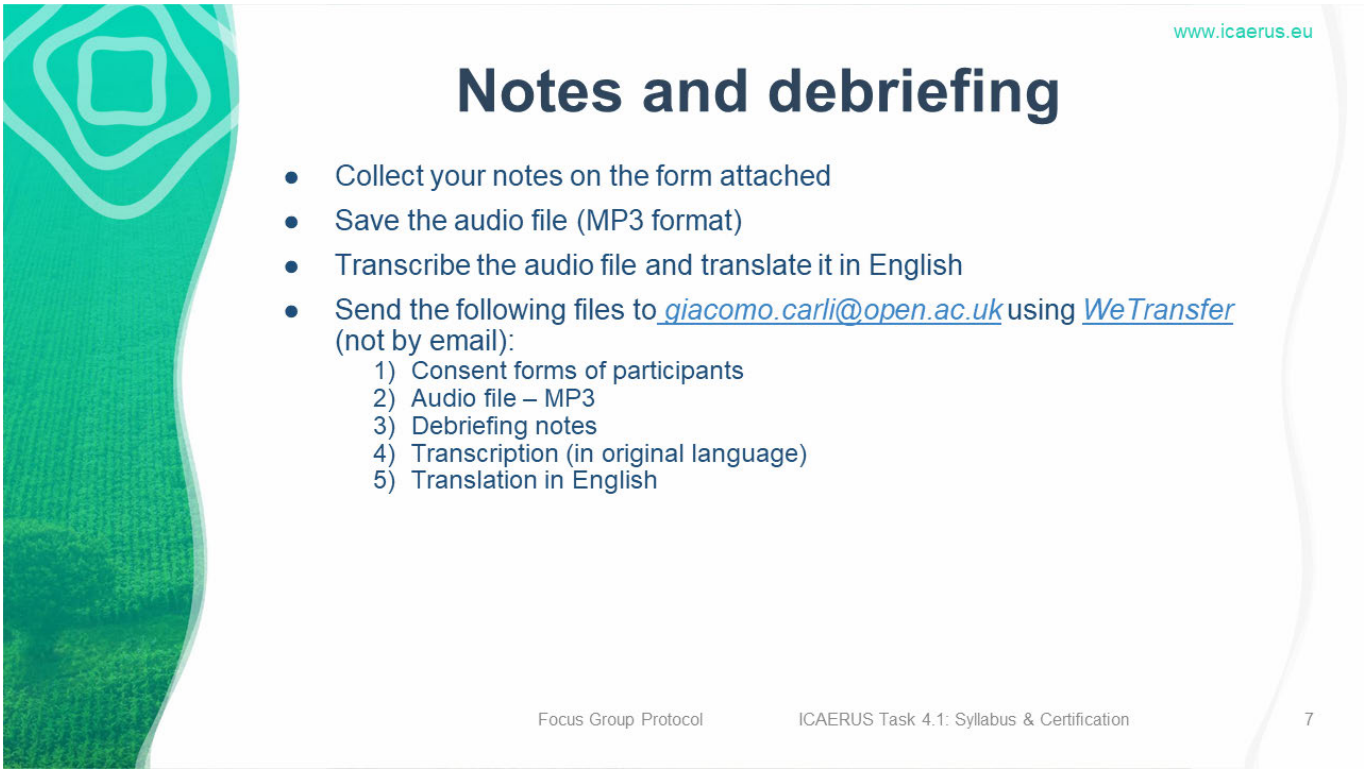
Introduction

On the day, the moderator should do the following things:

- Brief presentation of moderator and assistant (name, affiliation, role in the project); brief introduction of the project (1 slide) and of the use case (1 slide or very short video ~1 min)
- Brief introduction of the aim of focus group: slide attached
- Brief explanation about audio recordings (make the participants aware that their conversations are going to be recorded);
- Assurance about privacy policy (data will be treated and analysed jointly, and participants' identity will remain anonymous). Remember to ask each participant to sign the **consent form**.
- Brief explanation about focus group discussion rules and operation: each participant can express their ideas and opinions; there are no correct or wrong answers, and the aim of the discussion is to allow all the participants to express their opinion, even when divergent;
- Brief explanation to make participants understand that a collective discussion/conversation is the main goal, to talk about the topics under analysis. The moderator will present themes and topics to talk about, and participants will discuss together on those arguments. Participants should not address their comments and opinions to the moderator, whose tasks are only to make the discussion focus on the relevant topics, and stimulate it in case of need
- The **assistant** should take notes using the **debriefing form**
- Start with the first question (participants are invited to introduce themselves).

Focus Group Protocol ICAERUS Task 4.1: Syllabus & Certification 6



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Notes and debriefing

- Collect your notes on the form attached
- Save the audio file (MP3 format)
- Transcribe the audio file and translate it in English
- Send the following files to *giacomo.carli@open.ac.uk* using *WeTransfer* (not by email):
  1) Consent forms of participants
  2) Audio file – MP3
  3) Debriefing notes
  4) Transcription (in original language)
  5) Translation in English

Focus Group Protocol ICAERUS Task 4.1: Syllabus & Certification 7

END OF DOCUMENT