AgroPro

Agricultural Drone Technology Awareness Training for Industry Professionals (AgroPro)

e-Guide

Co-funded by the European Union

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Executive Summary

This report introduces the initial occupational profiles of the Agricultural Drone Professionals, a vital component of the AgroPro Project. The project includes numerous fundamental tasks: In the initial task, a questionnaire was developed and distributed via online channels such as social media and project websites, or individual approaches to the relevant stakeholders. Moreover, two-day workshops were held in each nation, led by a neutral facilitator, during which qualified Agricultural Drone Professionals defined basic duties and tasks inherent in their professions, capturing the relevant knowledge, abilities, and attributes. In the second task, detailed information about the different occupation profiles in the Agricultural Drone Professionals industry, including i. drone professional, ii. agriculture professional, was gathered. This essential information supports effective career guidance, emphasising support for adults in managing their careers, and enhancing the clarity of job prospects.

This report comprehensively lists all the identified Occupational Profiles, examines the impact of drone technologies on transforming the agricultural sector and creating new employment and livelihood opportunities in rural Europe, and investigates the collaborative efforts of educational institutions, government bodies, businesses, and civil society in addressing the challenge of preparing the agricultural sector for these emerging professions.

In summary, the AgroPro Project's commitment to developing these thorough occupational profiles is poised to serve as a crucial resource for stakeholders and individuals pursuing careers in this dynamic field, ensuring that workers acquire the knowledge, skills, and traits required for success in the era of drone technology.

Brief overview of the report's objective and key findings

The objective of this report is to provide a concise overview of the key findings and aims of the AgroPro Project's work package. The fundamental goal of this work package is to develop a comprehensive career e-Guide, focused on summarising the emerging professions within the agricultural sector, driven by technological advancements in the drone industry. This e-Guide, guided by the insights from a needs analysis and recommendations from CEDEFOP's 2018 Handbook of ICT[1] practices for guidance and career development, is targeted at educational institutions, particularly Training and Lifelong Learning Centers, career offices, tutors, and other stakeholders in the agricultural sector. The e-Guide's primary purpose is to support agriculture professionals interested in advancing their careers within the rapidly evolving field of drone technologies. The project's key outcomes involve identifying the knowledge and skills gap between current and required levels, documenting the fundamental aspects of the newly identified occupational profiles, and specifying the necessary learning outcomes associated with these profiles. Furthermore, the e-Guide, once completed, will facilitate the development of learning and training materials, providing individuals exploring career possibilities with increased autonomy and guiding them toward opportunities that enhance their postsecondary credentials. The e-Guide will serve as the foundation for the development of a Massive Open Online Course (MOOC) focused on the use of Unmanned Aerial Vehicles (UAVs) and associated digital tools for sustainable agriculture. It is poised to shed light on areas of interest for various stakeholders while uncovering the major challenges inherent in relevant agricultural occupations. In the course of this work package, two distinct occupational profiles have been identified, denoted as Drone Oriented, Agriculture Oriented. These profiles encapsulate the core responsibilities and competencies required for emerging roles within the agricultural sector, shaped by the advent of drone technology.

Figure 1 Adopted from www.unsplash.com Photo by Jason Blackeye

Introduction

Context of UAS (Unmanned Aerial Systems) technologies in agriculture

The effective and sustainable use of drones in agriculture is transforming the industry. They provide precision agricultural solutions that minimise the use of chemicals and water by irrigating or fertilising just certain regions. Considerable resource conservation may result from this productive agricultural technique. Drones can also help prevent crop loss and excessive pesticide usage by monitoring crop health and identifying pests or illnesses early on.

Advanced agricultural and livestock monitoring capabilities are provided by drones, which also provide high-resolution pictures and real-time data to support decision-making. They are time-efficient, provide economical solutions, and handle issues like leaks or contamination. Drones monitor cattle health and hazardous regions, which further improves safety. Furthermore, by carefully dousing insecticides and fertilisers, they lessen their influence on the environment.
Drone technology integration in agriculture is generating new jobs and sources of income. A well-managed drone ecosystem may create jobs inside the industry. The employment of drones in agriculture is also reducing worker hazards and increasing productivity.

The 'Drone Strategy 2.0'[2] announced by the EU comprises an optional 'trusted drone' labeling scheme in addition to standardising regulations for drone safety and security measures. Nonetheless, when it comes to the application of drone technology in agriculture, European laws are different. With respect to the countries involved in this project, the regulatory environment is still in its infancy. The Greek Digital Transformation Strategy for 2020–2025 suggests using drone technology for a number of agricultural applications, including remote forest surveillance to spot potential fire breakouts and enhancing animal living conditions by making pasture management easier. However, a lot of relevant interventions are necessary in this respect.

Drones are anticipated to make a useful contribution in distinct ways as technology develops. Drone usage in a variety of businesses is growing, despite early worries about privacy and regulatory issues. In comparison to Asia and the US, the EU has been slower to accept drone technology, although its application is growing.

Figure 2 Adopted from www.unsplash.com Photo by Ian Usher

Methodological Framework

Figure 3 Methodology procedure

Methodology

To develop the training program, a three-fold approach was adopted. First survey was developed targeting to professionals involved in the agriculture sector with the objective to identify the needs/the potential/skills of professionals involved in the agriculture deploying precision agriculture technologies and in specific drones. Then the storyboard technique was employed to explore the responsibilities and tasks of professionals with experience in the deployment of drones in the agriculture sector; at this step individual sessions with professionals were arranged. From the deducted information, initial occupational profiles were designed to reflect the responsibilities and the required knowledge of future drone professionals in the agriculture sector. Finally, the same professionals were called to participate in focus groups to validate the designated occupational profiles.

This process was developed to obtain the digital competences needed, the knowledge and skills needed.

1. Survey

Figure 4 Adopted from www.pexels.com Photo by Lukas

Objective

A survey was designed to gather input from agriculture professionals across various sectors, including companies, industries, academia, research, and unemployed individuals in the field. The survey's purpose was to identify the essential skills needed for professionals to effectively use drones in agriculture.

To ensure the survey's effectiveness, careful thought went into its development. The questions were created to cover a wide range of topics related to drone usage in agriculture. These questions explored areas such as technical expertise, knowledge of agricultural processes, familiarity with drone technology, data analysis abilities, and adherence to regulations.
The survey aimed to uncover the key skills necessary for professionals to make effective use of drones in agriculture. These skills were aligned with the DigComp framework components. By identifying these essential skills, the survey intends to create occupational profile, which describe a job in terms of specific duties and tasks that competent workers must perform.
The collected survey data was analysed to identify trends, patterns, and commonalities among the responses. This analysis provided valuable insights into existing skill gaps and areas that require further attention and development. Furthermore, it helped formulate the intended training program to bridge these gaps.

In summary, the survey aimed to gain a comprehensive understanding of the skills required for professionals to harness the potential of drones in agriculture. By including a diverse group of participants, the aim was to gather a complete understanding of the industry's needs and facilitate its progress towards a more efficient, sustainable, and technologically advanced future.

Blocks of questions

The questions were divided into four distinct blocks:

- Block one

The first block of questions named "Professional background", includes the following questions.

Questions:
○ In which country do you live?
○ What sector are you working or were working for?

Table 1 First block of questions

In this first block the main objective was to obtain information about the country where the professional was working from, and witch fields was he/she working in.

- Block two

The second block of questions named "Drone familiarisation", includes the following questions.

Questions:
○ How much are *you personally *familiar with drones?
○ How important is the knowledge in drone use in current professions?
○ How important will be the knowledge in drone use for future agriculture professions?
○ Please, indicate the potential of Drones to improve the following aspects in agricultural activities.

Table 2 Second block of questions

In the second block of questions the primary objective was to gather information regarding the professional's familiarity with drones, their understanding of the current and future significance of drones, and their insights on potential agricultural activities that could benefit from drone technology.

- Block three

The third block of questions named "Future agriculture activities", includes the following questions.

○ Questions starting with "Future agriculture professionals will need to be able to…":
○ Identify current and potential Drones applications in agriculture
○ Identify the relevant drone data for agriculture
○ Access and retrieve data from drones
○ Perform the interpretation and evaluation of drone data
○ Transform raw data to agricultural process variables
○ Organise drone data in a routine way in a structured environment
○ Easily operate the drone and its adjustments to weather conditions and mission

○ Share information retrieved from a drone through a variety of appropriate tools with the data restrictions that apply ○ Communicate the benefits and engage other agricultural professionals in drone use ○ Use digital tools and platforms to share data with agricultural stakeholders ○ Adapt communication strategies to an audience so that I can explain a drone implementation plan ○ Explain the more appropriate ways to protect stakeholders' identity ○ Indicate software and tools to create, edit, and analyse drone footage and/or data ○ Integrate and re-elaborate different data into interactive formats ○ Understand how licenses and regulations apply to drone usage and data ○ To list instructions for a drone software so that the program provides the desired results ○ Select certain safety and security measures to protect organisations and drone integrity ○ Differentiate risks and threats for drone software and tools ○ Take actions to be fully GDPR compliant in deploying Drones ○ Manage and store drone data securely ○ Design services with no human health and well-being damage from Drone use ○ Explain and design services that ensure minimum environmental impacts of drones in agriculture ○ Maintain and troubleshoot drones' hardware and software in agriculture ○ Identify drone technologies applied in agriculture available in the market. ○ Identify organisational needs and suitable technologies to satisfy them ○ Quickly list the benefits and concerns of Drones deployment in agriculture. ○ Identify tools and software that can be innovatively used with drones to solve problems in agriculture ○ Self-diagnose and update on competencies required for them and other agro drone professions ○ Be aware of national legislation and regulations on drone deployment ○ Hold a certification to be able to use drones in agriculture

Table 3 Third block of questions

In the third block of questions the primary objective was to collect information regarding the technological skills and knowledge an agriculture professional as. The questions were formulated with the DigComp framework in mind, and in section 2.1.3.1, we will delve deeper into this topic.

- Block four

The fourth and last block of questions named "Personal information", includes the following questions.

Questions:
What is your age?
What is your gender?

Table 4 Fourth block of Questions

In the fourth block of questions the primary objective was to gather data on the age and gender distribution of the professionals.

2. DigComp

The survey for AgroPro was developed using the Digital Competence Framework (DigComp)[3] for several specific reasons, outlined as follows.

1. DigComp provides a standardised framework that enables the assessment of digital competence across various domains, including agriculture. By leveraging DigComp, we ensure that our survey aligns with recognised guidelines and best practices in evaluating digital skills and competencies.

2. DigComp offers a comprehensive set of descriptors for digital competence, encompassing the knowledge, skills, and attitudes necessary for individuals to effectively operate in a digital society. By utilising DigComp, we can design a survey that adequately addresses the specific digital competencies required for utilising drones in agricultural practices, ensuring that all relevant aspects of the topic are covered.

3. DigComp is widely recognised and adopted by various organisations, educational institutions, and policymakers. By utilising this well-established framework in our survey, we enhance its credibility and ensure that our assessment aligns with existing initiatives in digital competence development. Additionally, it facilitates the integration of our survey results into broader digital competence frameworks and strategies.

In conclusion, choosing DigComp as the framework for the survey for AgroPro offers numerous benefits. It ensures that our assessment of digital competence in the context of drones in agriculture is comprehensive, standardised, adaptable, and compatible with broader digital competence initiatives. By leveraging DigComp, we can effectively evaluate and address the digital skills and competencies required for successful drone usage in the agricultural sector.
Block three

As previously mentioned, when developing the questions for the third block, careful consideration was given to the DigComp framework. The aim was to align the questions with the competencies outlined in DigComp to assess the respondent's technological skills and knowledge.

DigComp module	Questions starting with "Future agriculture professionals will need to be able to…":
1	Identify current and potential Drones applications in agriculture
1	Identify the relevant drone data for agriculture
1	Access and retrieve data from drones
1	Perform the interpretation and evaluation of drone data
1	Transform raw data to agricultural process variables
1	Organise drone data in a routine way in a structured environment
2	Easily operate the drone and its adjustments to weather conditions and mission
2	Share information retrieved from a drone through a variety of appropriate tools with the data restrictions that apply
2	Communicate the benefits and engage other agricultural professionals in drone use
2	Use digital tools and platforms to share data with agricultural stakeholders
2	Adapt communication strategies to an audience so that I can explain a drone implementation plan
2	Explain the more appropriate ways to protect stakeholders' identity
3	Indicate software and tools to create, edit, and analyse drone footage and/or data
3	Integrate and re-elaborate different data into interactive formats
3	Understand how licenses and regulations apply to drone usage and data
3	To list instructions for a drone software so that the program provides the desired results
4	Select certain safety and security measures to protect organisations and drone integrity
4	Differentiate risks and threats for drone software and tools
4	Take actions to be fully GDPR compliant in deploying Drones
4	Manage and store drone data securely
4	Design services with no human health and well-being damage from Drone use
4	Explain and design services that ensure minimum environmental impacts of drones in agriculture
5	Maintain and troubleshoot drones' hardware and software in agriculture
5	Identify drones' technologies applied in agriculture available in the market.
5	Identify organisational needs and suitable technologies to satisfy them
5	Quickly list the benefits and concerns of Drones deployment in agriculture.
5	Identify tools and software that can be innovatively used with drones to solve problems in agriculture
5	Self-diagnose and update on competencies required for them and other agro-drone professions
-	Be aware of national legislation and regulations on drone deployment
-	Hold a certification to be able to use drones in agriculture

Table 5 DigComp Connection with Questions for the module

The DigComp framework is divided in 5 different modules, which are the following:

1. **Information and Data Literacy:**

Information and data literacy involves the ability to express information needs and effectively locate and retrieve digital data, information, and content. It also entails the skill of evaluating the relevance and credibility of sources and their content. Additionally, being able to store, manage, and organise digital data, information, and content is crucial for efficient use and retrieval.

Figure 5 Adopted from www.unsplash.com Photo by Markus Spiske

2. **Communication and Collaboration:**

Communication and collaboration in digital environments are essential skills, encompassing the ability to interact, communicate, and collaborate using various digital technologies. It is important to be mindful of cultural and generational diversity while engaging in digital interactions. Active participation in society through public and private digital services, along with practicing participatory citizenship, enables individuals to contribute effectively to their communities. Managing one's digital presence, identity, and reputation is also an important aspect of this competency.

Figure 6 Adopted by www.unsplash.com Photo by Dylan Gillis

3. **Digital Content Creation:**

Digital content creation involves the creation and editing of various forms of digital content, such as documents, images, videos, and presentations. This competency also encompasses the skill of improving and integrating information and content into an existing body of knowledge while adhering to copyright and licensing guidelines. Furthermore, understanding how to provide clear and understandable instructions for computer systems is crucial for effective digital content creation.

Figure 7 Adopted from www.unsplash.com Photo by Nick Morrison

4. **Safety:**

Safety in digital environments encompasses several aspects. It involves protecting devices, content, personal data, and privacy from unauthorised access or malicious activities. Additionally, individuals need to be mindful of their physical and psychological well-being while engaging with digital technologies. Being aware of digital technologies that promote social well-being and social inclusion is important. Lastly, understanding the environmental impact of digital technologies and making responsible choices regarding their use contribute to this competency.

Figure 8 Adopted from www.pexels.com Photo by Pixabay

5. **Problem Solving:**

Problem solving in digital environments involves the ability to identify and address needs and problems effectively. This competency includes resolving conceptual problems and tackling problem situations using digital tools and resources. Utilising digital tools for innovation helps individuals find creative solutions and improve processes and products. Keeping up to date with the digital evolution and being open to continuous learning are essential for adapting to new challenges and advancements in the digital realm.

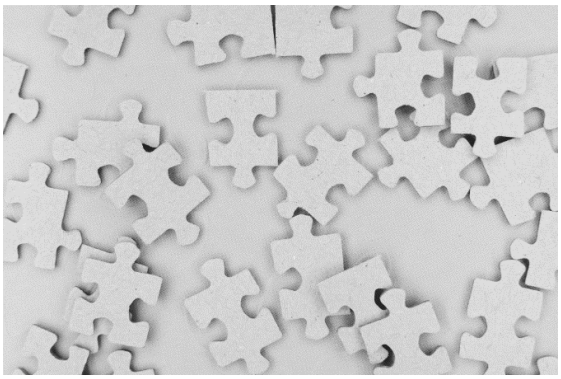


Figure 9 Adopted by www.unsplash.com Photo by Markus Winkl

3. Storyboard

After the survey was concluded a storyboard was created. This storyboard was developed through a series of interviews with Agricultural Drone Professionals. The interviews provided valuable insights into the diverse range of tasks and responsibilities that Agricultural Drone Professionals undertake, their day-to-day activities, challenges they faced, as well as the areas where drones can make a positive impact. These professionals shared their expertise and experiences to shape the storyboard. The professionals shared stories of using drones for tasks such as aerial mapping and surveying, crop health assessment, among others.

The interviews themselves were adeptly conducted in either the interviewees native languages or in English, based on individual preferences and comfort. To ensure comprehensive and structured information gathering during the interviews, a guideline consisting of seven key questions was prepared with the ESCO framework[4] in mind. These questions aimed to cover all the necessary aspects and gather relevant insights. The questions included were as follows:

Question	Expected outcome
What is your job title? How many years of experience do you have? How would you describe your job? For example, what activities are you conducting normally in a week?	Job profile.
How would you describe your daily tasks and which ones do you consider the most important? (Incentivise questions about data, applications, operations)	Main tasks and their level of importance.
What is the role of drone related technologies in your daily tasks and how did you decide the activities to include them in?	Possible drone applications.
What drone related drone-related technologies do you use and for what purposes? (drone, payload, software or any others according to the participants´ profiles)	Main technologies used.
What is the required knowledge someone in this field should have to successfully deploy drone applications in agriculture? (for applications)	Knowledge needed.
What is the required knowledge someone in this field should have to successfully exploit drone data in agriculture? (for data analysis)	Knowledge needed.
What type of skills do you consider someone in this field should have?	Skills needed.

Table 6 Interview Questions

Overall, the collaborative effort between skilled Agricultural Drone Professionals and the AgroPro team resulted in the identification of the tasks and responsibilities that an Agricultural Drone Professional can have and were drones can have a positive impact in agriculture.

4. ESCO

ESCO stands for European Skills, Competences, Qualifications, and Occupations. It is a multilingual classification system developed by the European Union (EU) to facilitate the exchange and comparison of data on skills, competences, qualifications, and occupations across EU member states. ESCO provides a standardised framework for describing and categorising various aspects of employment, including job titles, skills, qualifications, and tasks. By incorporating ESCO into the process of creating interview questions, the project benefited from a standardised and harmonised approach to assessing skills, competences, qualifications, and occupations.

5. Focus Group

Finally, to further refine the understanding of the required knowledge, skills, and attitudes for Agricultural Drone Professionals, AgroPro conducted focus groups in each of the countries: Portugal, Greece, and Cyprus. These focus groups provided an opportunity to gather insights directly from professionals working in the field. The focus groups were composed of Agricultural Drone Professionals.

To facilitate open and in-depth discussions, the focus groups utilised open-ended questions. This approach encouraged participants to share their perspectives, insights, and experiences freely, enabling a more comprehensive mapping of the requirements. To ensure an unbiased and neutral environment, a neutral facilitator moderated the focus groups.

The questions utilised were formulated to be open-ended, and they were as follows:

Question
Introduction (who they are, what they do)
What is your experience with drones in the agriculture sector? (Objective: introduction of participants)
What do you think that a professional in agriculture willing to use drones should know about drone technologies? (Objective: identify transversal technical skills)
What are the biggest challenges you face when operating or implementing drones in agriculture, and how do you overcome them? (Objective: identify technical and soft skills needed and not revealed in the workshops)
What are the minimum knowledge requirements for an agriculture professional to take full advantage of the potential benefits of drone-related technologies? (Objective: identify common sources of information from the experts -- knowledge)
How do you incorporate the data collected by drones into your daily operations? (Objective: identify skills related to deployment)
What should someone know about the software used for drone operations? (Objective: identify skills related to deployment)
Do you believe investing in this technology is a viable business opportunity? (Objective: identify skills related to technology management)
How do you stay up to date on the latest drone technology and regulations related to agriculture? How would you describe the evolution of the sector in the last 5 years? (Objective: identify skills related to resilience and flexibility)
What type of training or certification do you have to operate drones in agriculture?
What kind of collaborations among farmers and other stakeholders in agriculture are required for successful drone deployment? (Objective: identify skills related to system management)
Overall, what are current and potential outcomes of using drones in agriculture and how do you see this technology evolving in the coming years? And how do you plan to adapt to stay relevant in the field?

Table 7 Focus group questions

Overall, the focus groups refined and introduced the necessary knowledge, they provided a valuable opportunity to gather direct insights from professionals actively working in the field. With the insights obtained from these discussions a comprehensive mapping of the requirements for Agricultural Drone Professionals was created.

Occupational Profiles

The overarching aim of this data collection effort was to distil a profound understanding of the intricacies and nuances of responsibilities and competences associated with the roles of agriculture and drone professionals. By aligning our findings with the precise occupation profiles delineated within the ESCO framework, we achieved a holistic perspective that bridges the realms of theoretical frameworks and practical expertise.

List of roles and responsibilities

Drone Professionals

A "drone professional" according to ESCO would likely encompass individuals who possess the necessary skills, competences, and qualifications to operate, manage, and utilise drones (unmanned aerial vehicles) for various purposes. This could include roles such as drone pilots, drone operators, drone technicians, drone engineers, drone data analysts, and other related positions. The following are the skills and competences by occupation profile type, with their respective responsibilities and expert citations of the interviews.

Figure 10 Adopted from www.unsplash.com Photo by Triyansh Gill

Figure 11 Adopted from www.unsplash.com Photo by Sam Mcghe

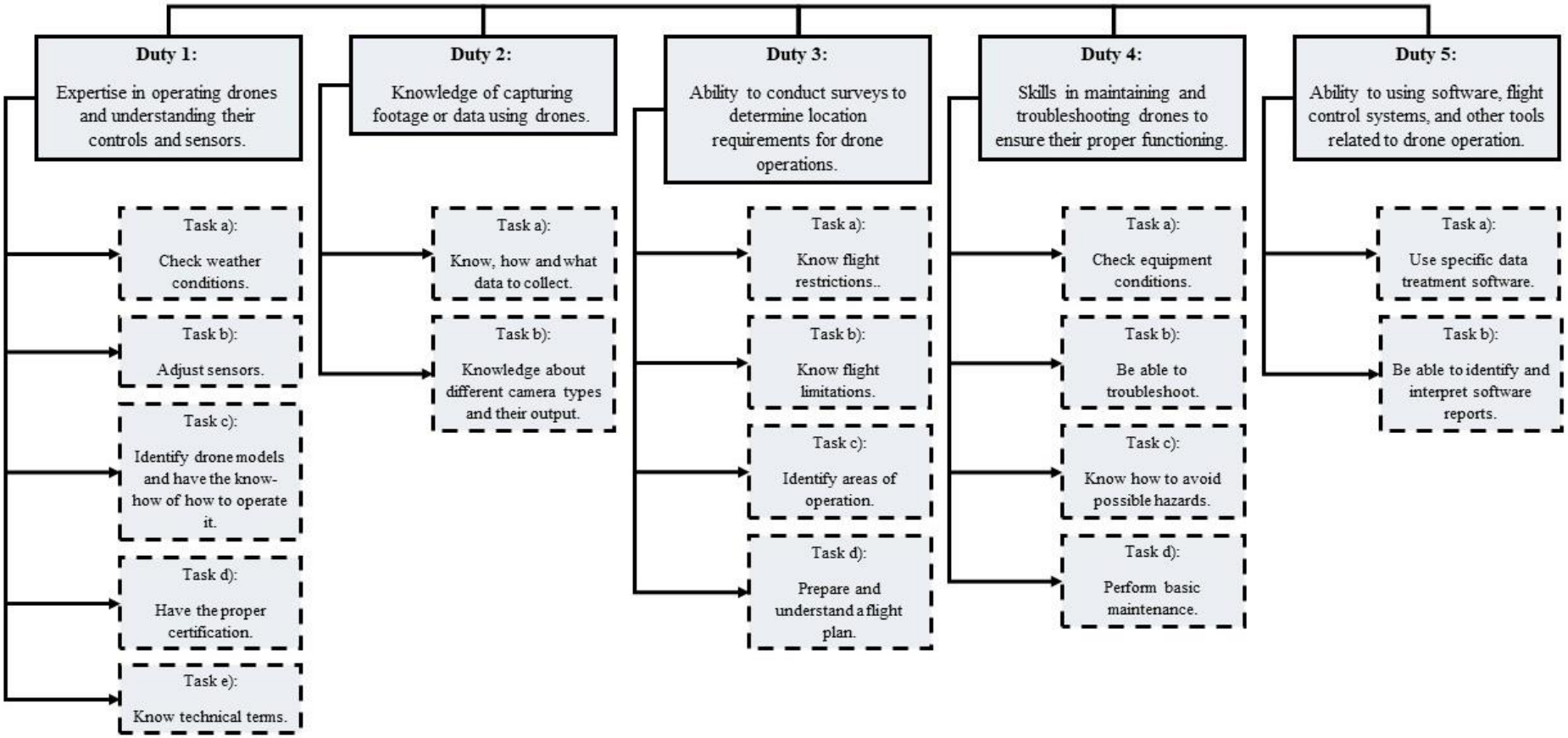


Figure 12Duties-tasks of Drone-Oriented Occupational Profile (i)

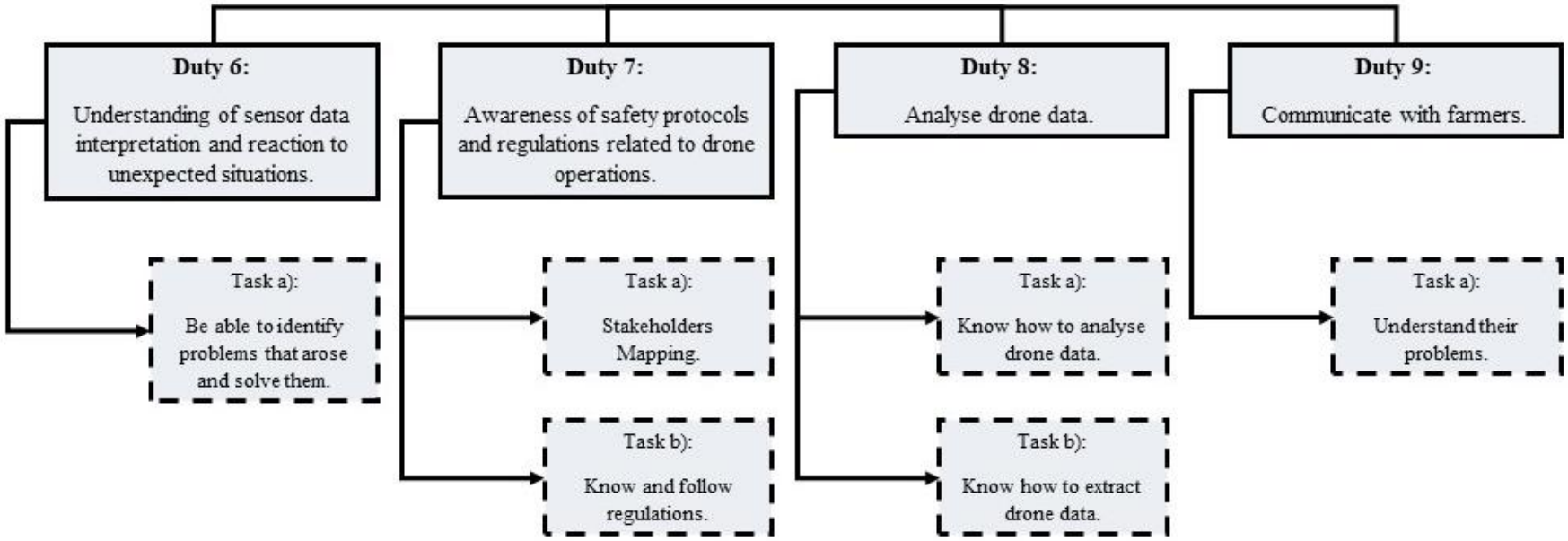


Figure 13Duties-tasks of Drone-Oriented Occupational Profile (ii)

Agriculture Professionals

An "agriculture profile" according to ESCO would likely encompass individuals who are involved in various aspects of agricultural activities, from cultivation and harvesting to livestock management and land stewardship. This profile might include roles such as farmers, agricultural technicians, agronomists, horticulturists, livestock managers, and other related positions within the agricultural sector.

Figure 14 Adopted from www.unsplash.com Photo by Jan Kopriva

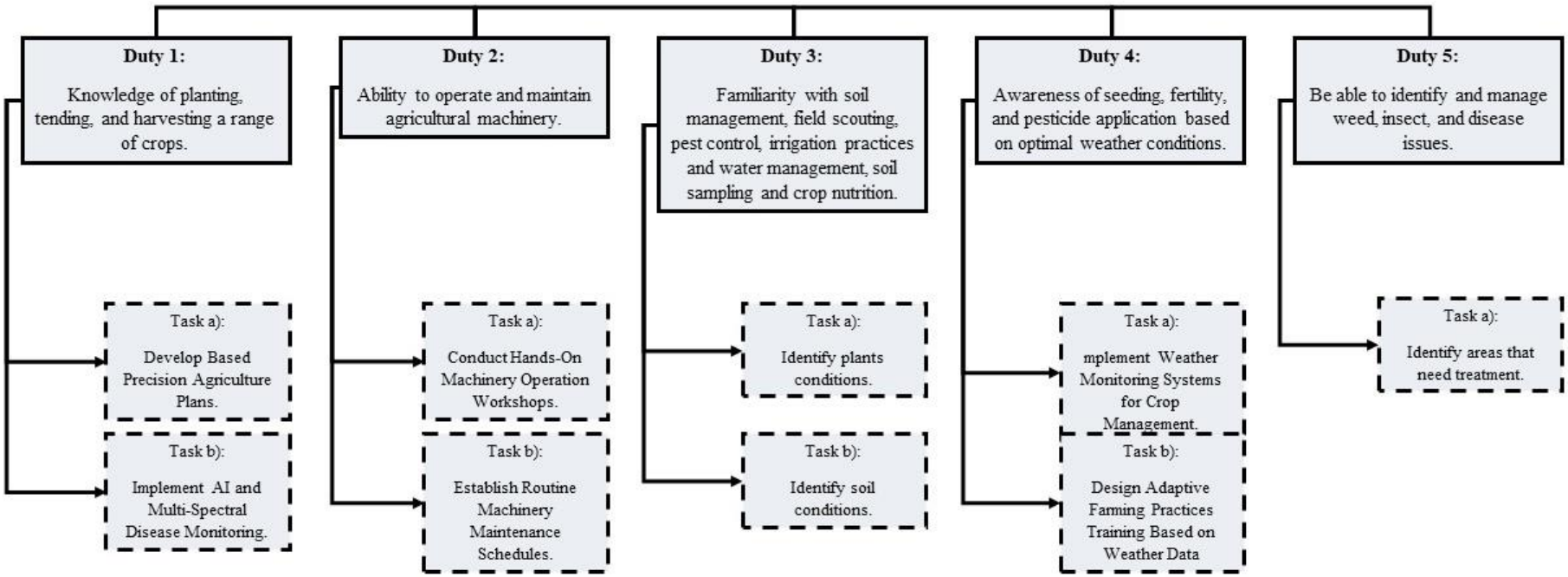


Figure 15Duties-tasks of Agriculture-Oriented Occupational Profile (i)

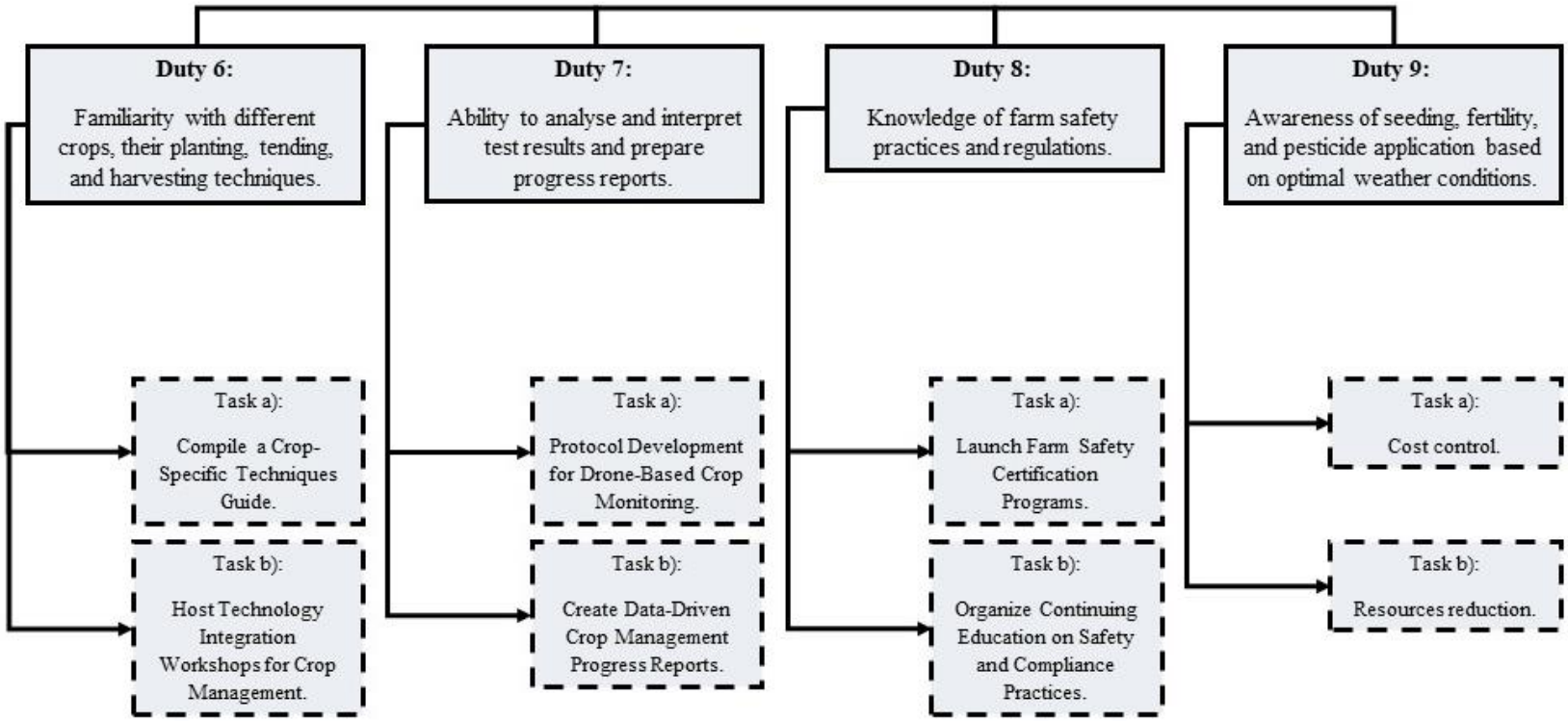


Figure 16 Duties-tasks of Agriculture-Oriented Occupational Profile (ii)

Required skills and competencies

Transversal skills

Thinking (cognitive) skills relate to the ability to apply the mental processes of gathering, conceptualising, analysing, synthesising, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication. This is demonstrated by using information of different kinds to plan activities, achieve goals, solve problems, deal with issues and perform complex tasks in routine and novel ways.

- Planning and organising

The planning and organising cluster of thinking skills and competences is generalised from various cross-sector and sector specific formulations, as well as 'planning and scheduling events and activities'. It reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Plan activities
- Organise information, objects and resources
- Multi-task

Regarding organisational skills, it merges a variety of skills such as 'apply conceptual thinking', 'structure information', 'store information', and 'organise information'.

- Dealing with problems

The dealing with problems cluster of thinking skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Identify problems
- Solve problems

- Thinking creatively and innovatively

The thinking creatively and innovatively cluster of thinking skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Think innovatively
- Think creatively
- Improvise

Social and communication skills relate to the ability to interact positively and productively with others. This is demonstrated by communicating ideas effectively and empathetically, coordinating one's own objectives and actions with those of others, seeking resolutions to differences, building trust and settling conflicts, ensuring the well-being and progress of others, managing activities and offering leadership.

- Communicating

The communicating cluster of social and communication skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Moderate discussions
- Resolve conflict
- Negotiate
- Promote ideas, products, services
- Report

- Supporting others

The supporting others cluster of social and communication skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Show empathy
- Ensure customer orientation
- Couch, mentor or advise others
- Teach, train or instruct others

- Collaborating in teams and network

The collaborating in teams and network cluster of social and communication skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Interact with others
- Build and maintain networks
- Work in teams
- Demonstrate intercultural competence

- Leading others

The leading others cluster of social and communication skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Delegate responsibilities
- Motivate others
- Build team spirit

- *Following ethical code of conduct*

The following ethical code of conduct others cluster of social and communication skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Comply with regulations
- Respect confidentiality obligations
- Demonstrate loyalty

- Demonstrate trustworthiness

Physical and manual skills refer to the ability to perform tasks and activities which require manual dexterity, agility and/or bodily strength. They may be carried out in demanding or hazardous environments requiring endurance or stamina. These tasks and activities may be carried out by hand, with other direct physical intervention, or by using equipment, tools or technology which requires guidance, movement or force, such as ICT devices, machinery, craft or musical instruments.

- Manipulating and controlling objects and equipment

The manipulating and controlling objects and equipment cluster of physical and manual skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Move and lift objects
- Use equipment, tools or technology with precision

This cluster of skills is integrated with the following technical and more specific drones' skills & competences.

- Responding to physical circumstances

The responding to physical circumstances cluster of physical and manual skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Adjust to physical demands
- React quickly to physical changes or hazards

Considering the usage of drones' technologies in the agricultural sector, this cluster of skills is related to the ability of timely reaction to technical and operational risks including malfunctions, failures, errors, or interference that could affect the performance, control, or communication of the drone. These risks may cause drone to crash, lose power, fly away, or damage property or people.

Potential hazards vary according to the mission however, common related hazards include:

- Buildings
- Trees and other plants
- Bodies of water
- Geographical attributes (cliffs, hills, embankments)
- Traffic that could move through the flight plan
- Animals
- People presently in or near the flight plan and people who could potentially enter into the flight space during the flight.
- Powerlines and power infrastructure
- Weather and wind

The pre-flight checklist must include a thorough inspection of the drone to ensure it is functioning and airworthy. This includes checks on the airframe, batteries and drive train. It is also necessary to check that the controller is functioning correctly. Once the pre-flight checklist is completed and the airspace requirements (NOTAM, weather, airspace class etc.) are met, the operator/pilot should thoroughly observe the flight path to identify potential hazards and ways of mitigating them. The flight plan must then be updated to include the hazards and how it is intended to avoid them. This may often be done implicitly through the flight path and navigation system, however, it is necessary to continuously monitor the environment for changes that present new hazards during the mission.

Transversal competences

Core competences refer to the ability to understand, speak, read and write language(s), to work with numbers and measures and use digital devices and applications. Core skills and competences represent the foundation for interacting with others and for developing and learning as an individual.

- Working with numbers and measures

The working with numbers and measures cluster of core skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Interpret mathematical information
- Carry out calculations
- Work with probabilities
- Process spatial information

- Working with digital devices and applications

The working with digital devices and applications cluster of core skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Operate digital hardware
- Conduct web searches
- Use communications software
- Manage digital identity
- Apply digital security measures
- Create and edit digital content
- Use coding skills

This cluster of skills is integrated with the following technical and more specific drones' skills & competences.

Thinking (cognitive) competences relate to the ability to apply the mental processes of gathering, conceptualising, analysing, synthesising, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication. This

is demonstrated by using information of different kinds to plan activities, achieve goals, solve problems, deal with issues and perform complex tasks in routine and novel ways.

- Processing information, ideas and concepts

The processing information, ideas and concepts cluster of thinking skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Think analytically
- Think critically
- Think holistically
- Think quickly

The self-management competences require the individual to understand and control his/her own strengths and limitations and use this self-awareness to manage activities in a variety of contexts. This is demonstrated by an ability to act reflectively, responsibly and in ways which are structured according to values, by accepting feedback, and by seeking opportunities for personal and professional development.

- Taking a proactive approach

The taking a proactive approach cluster of self-management skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Show initiative
- Make decisions
- Assume responsibility
- Show commitment
- Show determination
- Manage personal progression

- Maintaining a positive attitude

The maintaining a positive attitude cluster of self-management skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Cope with uncertainty
- Manage frustration
- Cope with stress

- Demonstrating willingness to learn

The demonstrating willingness to learn cluster of self-management skills and competences reflects the following concepts customised to specific circumstances and occasions of agricultural drones' technologies:

- Adapt to change
- Keep an open mind

- Accept criticism and guidance
- Exercise self-reflection
- Demonstrate curiosity

Agricultural skills

- Planting, tending, and harvesting a range of crops

This entails having a thorough grasp of every stage of a crop's lifespan, from planting seeds to harvesting mature plants. To maximise crop productivity and keep farming operations sustainable, this skill is essential. Specific planting requirements for each crop include the best soil conditions, planting depth, and spacing. Planting at the right time of year is also important since some crops have distinct development cycles and require precise planting window timings based on environmental factors. Crop care entails a variety of tasks intended to encourage robust development and shield crops against insect or weed competition. This might involve actions like fertiliser application to supply vital nutrients, weeding to lessen competition for water and nutrients, and trimming to enhance plant structure. Certain crops could also need special supports, such as trellises for climbing plants. Depending on the crop, there are significant differences in harvesting methods. Certain crops may only be picked by hand, and in order to avoid damaging delicate fruits and vegetables, this is frequently required. Others may be harvested with the aid of machines or manual tools, particularly in large-scale farming operations when productivity is crucial. To guarantee that crops are harvested at the height of their ripeness and nutritional value, harvest time is essential.

- Operate and maintain agricultural machinery

In order to increase the productivity and efficiency of agricultural chores, tractors, harvesters, and other specialised equipment are used. To guarantee that agricultural machinery is operating correctly and effectively, expert supervision and monitoring are necessary. This includes being able to use GPS technology for navigation, observe dials and gauges, and change the settings of machines according to the demands of various activities. Maintaining the apparatus in excellent operating condition is similarly critical. This includes performing routine inspections, identifying and resolving any functioning issues, and replacing or repairing parts with the appropriate equipment. Frequent maintenance averts malfunctions that can impede farming operations and necessitate expensive repairs. Operators of farm machinery also need to be familiar with the many attachments and tools used for different farming operations, such planting, harvesting, and plowing. For the task at hand, they must choose the proper equipment and attachments, and they must also know how to install and operate them properly. Keeping agricultural gear safe to use and maintain is essential and operators are required to follow safety guidelines in order to avoid mishaps and injuries.

- Decision-making on sowing, fertility and pesticide application manage weed, insect, and disease issues

This requires a thorough comprehension of the many variables affecting crop health and growth. Farmers must choose what, when, and where to plant while taking the climate and unique requirements of various crops into consideration. The unique circumstances of the farm, social relationships, and personal experiences all play a part in this dynamic and intricate decision-making process. Managing fertility is yet another essential component of this ability. It includes methods and techniques to preserve and enhance the health of the soil, such applying organic fertilisers, cover crops, and manure. It is important for farmers to comprehend the nutritional requirements of their crops and devise sustainable methods to fulfil them. Using pesticides is essential for controlling weeds, illnesses, and pests. Because correct application procedures are crucial to the safety and efficacy of pesticide usage, this calls for a high degree of competence and understanding. Farmers must recognise the pests they are facing, select the best insecticide, and administer it correctly and on schedule. Farmers must think about the effects of their actions on the environment and human health in addition to these technical factors. For instance, using pesticides can have a detrimental impact on human health as well as pollute the land, water, and air. Consequently, farmers must exercise caution while using pesticides and seek out methods to reduce their usage, such as by implementing integrated pest control techniques.

- Data analysis

To improve agricultural operations and decision-making, massive volumes of data must be gathered, analysed, and interpreted. With the use of this skill, farming may be done more precisely. More effective management of agricultural equipment is made possible by data on machine operation, such as speed, fuel consumption, and diagnostics. Agronomic information that is pertinent to crop management includes planting density, moisture content, and grain temperature at harvest. Farmers may decide when to plant, how to fertilise, and how best to manage their resources by evaluating this data. Big data analytics is being used in agriculture to track vital data such as fertiliser requirements, rainfall patterns, and water cycles. This increases production and gives farmers the information they need to manage their crops more intelligently. Additionally, data analysis may help with more efficient supply chain management by ensuring that agricultural goods are stored and delivered in a way that preserves their quality.

- Agricultural budgeting and cost monitoring

To improve agricultural practices and decision-making, it entails rigorous planning and monitoring of financial resources. With the use of this ability, farming may be done more precisely, with data on expenses, profits, and other variables being utilised to enhance agricultural operations. Farmers must maintain account of all costs associated with their farming operations, including land, labour, machinery, inputs, taxes, and interest. Farmers may plan their budget, determine their break-even point, and assess their efficiency in comparison to standards by evaluating this data. In a similar vein, tracking income enables farmers to assess their profitability, modify their pricing policy, and enhance their marketing mix. In agriculture,

budgeting also includes projecting the anticipated revenue, costs, and profit of a certain farm plan in order to evaluate the financial viability of various agricultural approaches. This increases production and gives farmers the information they need to manage their crops more intelligently. Additionally, budgeting may help with more efficient supply chain management by ensuring that agricultural goods are stored and delivered in a way that preserves their quality.

Agricultural competences

- Pest identification

This competence entails being able to identify a wide range of pests, such as weeds, rodents, insects, and illnesses. Comprehension of their life cycles and activities is essential to this process. It can be difficult to identify anything accurately; it frequently involves close observation and examination of damage patterns. There may be situations where laboratory work is required. Digital image technologies, hand lenses, and microscopes are a few examples of tools that might be used in this procedure. Finding the best management methods requires an understanding of the life cycle and behaviour of the pest. With an estimated 20% to 40% of worldwide agricultural productivity lost to pests annually, pests constitute a serious danger to crop harvests. By changing the distribution and behaviour of pests, factors like climate change have the potential to worsen these effects. Pest identification is an important agricultural competence, despite its difficulty. It is essential for reducing the impact on agricultural productivity and for efficient pest management.

- Identify plants conditions

Plant disease and stress detection is a crucial agricultural competence. This approach generally uses time-consuming, insufficient visual examination. To help, AI-based apps diagnose plant illnesses. Many methods for identifying plant diseases are laborious, involve expert personnel, and require a lab. New optical sensors use electromagnetic spectrum to detect plant stressors and provide precise information. This includes identifying black spot, leaf spot, and mildew. Environmental elements including light, temperature, water, humidity, and nutrition are considered to detect environmental stress-related plant diseases. Automatic disease detection and categorisation can detect symptoms early, minimising big farm monitoring labour. Leaf spots, blight, chlorosis, necrosis, and wilt are plant disease symptoms. Sustainable agriculture requires effective, cheap, and eco-friendly plant disease control.

- Identify soil conditions

Visual inspection can reveal the soil type (sand, silt, clay, organic matter) and its qualities (plasticity, cohesion, drainage). Visual examination needs to be supplemented by laboratory testing, particle size analysis, and field measurements. Compaction, drainage, erosion, pH imbalance, air shortage, and water levels are common soil challenges. Managing these concerns involves minimising soil compaction, improving drainage, managing erosion, changing soil pH, and maintaining water levels. Land-use and management alter pH, bulk density, and soil organic matter concentration, which affect soil health. Maintaining carbon transformations, nutrient cycles, and soil structure is vital to soil health. Technology has also improved soil

condition detection. Soil sensors and AI-powered soil mapping identify soil-borne illnesses and pests early. Immersive technology let farmers see and evaluate soil data for pattern recognition and decision-making. Finally, soil health goes beyond physical and chemical qualities. It also involves soil bacteria, fungus, and other microorganisms that build an exquisite symbiotic environment. These organisms affect soil formation, structure, and productivity.

- Identify areas that need treatment

This refers to an overview of the areas that have to be assessed. Visual inspection is often the first step, but it is not enough. Laboratory testing, field measurements, and technology must be included. Precision agriculture technology like GPS data and AI-powered mapping may boost output and reduce seed and fertiliser waste. These tools can also help farmers spot illnesses and pests early and make educated judgments. Poor soil compaction, drainage, erosion, pH imbalance, and water levels may necessitate remediation and they should be managed via improving drainage, preventing erosion, changing soil pH, and maintaining water levels. Besides physical circumstances, farmers must be mindful of agricultural health dangers due to exposure to dangerous substances. Moreover, agriculture goes beyond physical and chemical components. It also involves soil microorganisms including bacteria, fungus, and others that form a symbiotic environment. These organisms affect soil health and production, and their presence or absence might suggest remedial needs.

- Field monitoring

Field monitoring is essential to farming. It entails constant monitoring and evaluation of farming aspects. Optimal crop growth and farm health depend on this mechanism. Field monitoring relies heavily on visual assessment. This conventional process has been greatly improved by technology. Today, farmers employ various instruments and technology to monitor their farms more efficiently. Remote sensing devices, wireless sensors, and innovative software applications deliver real-time field data and insights. Some farmers take satellite photographs of their land using remote sensing. This technology lets them track progress and anticipate issues. It also accurately estimates plant biomass and leaf area index, which are important plant health markers. Another significant field monitoring tool is wireless sensors. At various field sites, these sensors collect data on numerous characteristics. Analysis of this data reveals weather patterns, soil fertility, crop quality, and other significant elements. Wireless sensors capture data reliably, accurately, and efficiently. Field monitoring also relies on software. These apps give farmers real-time field data. They can monitor soil moisture, analyse trends and data, and receive intervention warnings. This helps farmers make educated decisions and handle challenges quickly.

- Cost control

In order to sustain profitability, managing and cutting costs related to farm operations is a crucial competence in the agricultural industry. Farmers need to be proactive in identifying cost-saving measures due to the increase in production costs. This entails keeping a careful eye on KPIs and making well-informed selections when making purchases, such as weighing the pros and cons of various suppliers' seeds and fertilisers. By utilising precision agriculture

technology, farmers may increase output and decrease waste by making more economical use of inputs like seeds and fertilisers. Furthermore, concentrating on fixed costs—which frequently account for a higher share of overall expenses—can offer noteworthy chances to influence profitability. This is because when a significant percentage of expenditures are fixed, standard cost management tactics that emphasise variable costs may have less of an impact. Realistic cost-cutting strategies include enhancing farm equipment, lowering farmland leasing rentals, and effectively managing weeds and pests. Farmers should also think about the financial advantages of taking precautions to safeguard the environment and their employees.

- Resources reduce

The necessity of sustainable and effective farming methods is emphasised by the "Resources Reduce" notion in agricultural competence. This is brought on by both an increase in the demand for agricultural products and a decline in natural resources, which is partially attributable to certain farming practices. The environment is greatly impacted by agriculture, which causes pollution, habitat loss, and climate change. The main causes of this problem are excessive use of pesticides and fertilisers, deforestation for agricultural development, and overuse of water. To meet these issues, efforts are being made to promote sustainable agricultural methods. These methods seek to minimise waste, maximise resource utilisation, and lessen farming's negative environmental effects. Data on crop health is being gathered using technologies such as the Internet of Things (IoT), which may subsequently be utilised to increase farming productivity. Reducing emissions and enhancing environmental performance also involves the use of modern farming techniques and conservation technology. Additionally, the concept promotes reduction, reuse, and recycling in agriculture. Furthermore, it is critical to mitigate and adapt to the consequences of climate change on agriculture. This might entail optimising feeding and grazing techniques, as well as more effective irrigation and fertiliser use, in order to lessen agricultural operations' susceptibility to climate change. "Resources Reduce" is essentially about using efficient and sustainable agricultural methods to guarantee agriculture's long-term survival in the face of rising demand and depleting resources.

- Identify weed, insect, and disease issues

This entails identifying and controlling weed, insect, and disease-related issues that have the potential to seriously compromise crop health and productivity. While insects and illnesses can directly harm crops or cause crop loss, weeds compete with crops for the same nutrients. To find these problems, field monitoring must be done on a regular basis to look for disease or infestation indicators. Once recognised, there are a number of strategies that may be employed to address these problems, such as crop rotation, insecticides, and disease-resistant crop types. However, because of the possibility for pesticide resistance in diseases and pests as well as environmental concerns, sustainable approaches are frequently used. An important tactic is integrated pest management, which employs a variety of techniques to manage illnesses and pests while lowering the need for chemical pesticides and preserving the ecosystem. This covers cultural and biological control strategies, such as changing farming techniques to create an environment that is less conducive to illnesses and pests, and the use of natural insect predators.

- Familiarity with different crops, their planting, tending, and harvesting techniques

This refers to a thorough comprehension of the distinct requirements of different types of crops and the techniques for tending to them during the course of their lives. To maximise crop health, production, and agricultural operations' sustainability, this information is essential. Specific planting requirements for each crop include the best soil conditions, planting depth, and spacing. For example, many crops might do well with close spacing, whereas others need more space to flourish. Planting at the right time of year is also important since some crops have distinct development cycles and require precise planting window timings based on environmental factors. Crop care entails a variety of tasks intended to encourage robust development and shield crops against insect or weed competition. This might involve actions like fertiliser application to supply vital nutrients, weeding to lessen competition for water and nutrients, and trimming to enhance plant structure. Certain crops could also need special supports, such as trellises for climbing plants. Depending on the crop, there are significant differences in harvesting methods. Certain crops may only be picked by hand, and in order to avoid damaging delicate fruits and vegetables, this is frequently required. Others may be harvested with the aid of machines or manual tools, particularly in large-scale farming operations when productivity is crucial. To guarantee that crops are harvested at the height of their ripeness and nutritional value, harvest time is essential.

- Safety regulations on farms

This refers to the knowledge and implementation of safety regulations in agricultural activities. This is essential to avoid mishaps and injuries, as well as to safeguard the health and welfare of farm staff. Farms may be dangerous places with dangers ranging from exposure to dangerous chemicals to accidents involving machinery. As a result, safety laws address many different topics. To avoid mishaps, regulations are in place for the upkeep and use of farm equipment, for example. This involves making certain that the equipment is in excellent operating order, that the operators have received the appropriate training, and that safety equipment is utilised as required. Chemical handling and storage, including that of fertilisers and pesticides, is governed by safety laws as well. If these compounds are not handled properly, they can be dangerous or even fatal. For this reason, laws mandate that they be handled with caution and that they be kept in a secure manner. Animal handling is a key component of agricultural safety. Because there is a chance that an animal can hurt a worker, safety standards mandate that personnel be taught in safe animal handling procedures and that the proper safety equipment be utilised. Farm safety rules mandate that a broad risk assessment be conducted to identify possible risks on the farm, in addition to these specific categories. This should involve taking steps to reduce these hazards, such educating employees, keeping equipment in good operating order, and making sure safe work procedures are followed.

- Organise product transport

This refers to transferring agricultural products from their point of origin to their ultimate destination. Ensuring effective agricultural operations, avoiding losses, and preserving product quality all depend on this procedure. Farm produce transportation is a difficult undertaking that has to be carefully planned. To avoid contamination and damage, things should be adequately

covered and vehicles should be kept clean. Frequent inspections of refrigeration equipment are required for items that require cooling. Temperature, humidity, and handling are a few examples of elements that might impact quality during transportation. Controlling these variables is crucial as a result. For example, after harvested, food has to be cooled down fast, and high humidity levels are ideal for most produce. Managing the seasonality and perishability of crops is a major logistical difficulty in agriculture. This may result in more expenses, waste, and delays. Thus, it is essential to make investments in the development of infrastructure, such as constructing cold storage facilities and repairing highways. Another crucial factor is the sustainability of the transportation systems. Transport alternatives that do not use fossil fuels, such electric and clean diesel vehicles, can improve the sustainability of agricultural transportation. Finally, it is critical to follow safety guidelines when transporting agricultural goods. This involves making certain that connections and cars are safe and clean. For some items to be cleared through customs at the country of destination, certain documentation may be needed.

Drones skills

- Operating drones and understanding their controls and sensors

"Operating Drones and Understanding Their Controls and Sensors" involves the use of drone systems, encompassing the ability to navigate, manipulate controls, and comprehend sensor functionalities. Professionals with this competence demonstrate skill in piloting drones, managing flight dynamics, and employing various sensors to collect data effectively. They understand the diversifications of remote control interfaces, ensuring precise control over drone movements. Additionally, they possess knowledge of sensor technologies, enabling them to optimise data acquisition for specific tasks. This competence empowers individuals to execute drone operations with precision, leveraging advanced features and sensor capabilities for accurate and reliable outcomes.

- Capturing footage or data using drones

Capturing Drone Footage or Data entails the proficiency in utilising drones to record visual content or gather data for various applications. Individuals with this competence are adept at operating drones to capture high-quality footage or collect data through onboard sensors. They possess skills in planning flight paths, adjusting camera settings, and ensuring optimal data collection during drone operations. This competence is crucial for professionals engaged in tasks such as aerial photography, surveying, or environmental monitoring, as it ensures the effective utilisation of drone technology to obtain valuable visual or informational outputs.

- Determining location for drone operations

Determining the optimal location for Drone Operations involves the ability to strategically identify and select suitable areas for drone activities. Individuals with this competence possess the skills to assess environmental conditions, regulatory constraints, and specific project requirements to choose optimal locations for drone operations. This includes considering factors such as airspace regulations, safety zones, and the nature of the task at hand. This

competency is crucial for drone operators and professionals who need to plan and execute drone missions in diverse settings, ensuring compliance with regulations and achieving successful outcomes applications such as agriculture.

- Troubleshooting drones

Troubleshooting drone issues involves the capacity to identify and address technical issues or malfunctions that may arise during drone operations. Individuals possessing this competency have the skills to diagnose problems with the drone's hardware, software, or communication systems and apply appropriate solutions to ensure the smooth functioning of the drone. This competence is essential for both drone operators, technicians, and professionals involved in maintaining and optimising drone performance in various applications, including aerial photography, surveying, and data collection. It requires a comprehensive understanding of drone systems and their mounted components, as well as the ability to respond effectively to unexpected challenges to minimise disruptions and ensure the successful completion of tasks.

- Using software, flight control systems, and other tools related to drone operation

The use of digital drone tools, such as Flight Control Systems or other drone-related software encompasses the adept utilisation of various technologies essential for effective drone management. Those with this skill possess the ability to navigate and operate drone-specific software, flight control systems, and associated tools. This competence is vital for drone operators and professionals engaged in tasks such as mission planning, data analysis, and real-time monitoring. It requires proficiency in understanding and leveraging the capabilities of specialised software applications designed for drone operations, enhancing the overall efficiency and precision of drone-related tasks.

- Interpreting sensor data

Interpreting sensor data is a skill that involves the understanding and making sense of information gathered by various sensors on a drone. Professionals with this capability can analyse and interpret data collected by sensors, such as cameras, LiDAR, or other specialised devices mounted on drones. This skill is crucial for extracting meaningful insights from the sensory input, enabling informed decision-making during drone operations. Individuals proficient in interpreting sensor data can identify patterns, anomalies, or relevant information, contributing to effective problem-solving and achieving desired outcomes in diverse applications, including agriculture.

- Reacting to unexpected situations

As the drone sector is full of risks, the competency of quickly and efficiently reacting to unexpected situations entails the ability to respond promptly and effectively to unforeseen events or challenges during drone operations. Professionals possessing this skill can navigate and timely adapt to unexpected circumstances, such as adverse weather conditions, technical malfunctions, or unforeseen obstacles. Reacting swiftly and making informed decisions in these situations is crucial for ensuring the safety of the drone, compliance with regulations, and the success of the mission. Individuals with this competence are adept at troubleshooting,

adjusting flight plans, and implementing contingency measures to address unexpected challenges, contributing to the overall efficiency and reliability of drone operations.

- Analyse drone data

This skill involves the ability to interpret and extract meaningful insights from the data collected by drones during their operations. Individuals with this skill are proficient in using data analysis tools and techniques to process, evaluate, and draw conclusions from the diverse datasets generated by drone sensors. This competency is crucial in agriculture application, where the analysis of drone data can provide valuable information for decision-making and farm management. Professionals possessing this skill contribute to the optimisation of processes, identification of patterns, and the extraction of actionable intelligence from the wealth of data acquired through drone missions over agricultural fields, and in occasions, rural areas in general.

Drones competences

- Safety protocols and regulations related to drone operations

Understanding safety protocols and regulations related to drone operations is a crucial skill for anyone involved in drone usage. This proficiency encompasses a comprehensive grasp of the legal frameworks, guidelines, and safety measures governing drone flights. It involves knowledge about designated flying zones, obtaining the necessary licenses, and compliance with regulatory requirements. It covers the essentials of prioritising safety, navigating the rules, and adhering to responsible drone flying practices. Topics include a solid understanding of drone theory, such as permissible flying zones, necessary licenses and legal considerations, as well as practical competences such as pre-flight drone checks, handling emergencies, and risk management.

- Checking weather conditions

Proficiency in checking weather conditions is an essential skill for drone operators, contributing to safe and effective flight operations. This skill involves the ability to assess various meteorological factors such as wind speed, precipitation, visibility, and temperature. Drone operators need to understand how weather conditions can impact flight stability and the overall safety of the operation. This skill enables drone pilots to make informed decisions about whether it is suitable to fly, ensuring that weather conditions align with regulatory and safety requirements. Being adept at obtaining information and using various weather forecasting tools enhances the capability to plan flights strategically, avoiding potential hazards and ensuring optimal performance of the drone. It underscores the importance of real-time weather monitoring, contributing to responsible and secure drone operations in diverse environmental scenarios.

- Adjusting sensors

The skill of adjusting sensors revolves around the theoretical knowledge and technical ability and expertise to fine-tune and optimise various sensors mounted the drone. Drone operators

proficient in this skill possess the knowledge to calibrate sensors such as cameras, LiDAR, and other data-collecting devices for precise data acquisition. This skill extends to understanding the impact of environmental conditions on sensor performance and making necessary adjustments to ensure accurate data collection. Whether it's optimising camera settings for capturing high-quality images or calibrating sensors for accurate mapping and surveying, this skill is fundamental for achieving reliable and meaningful results in agricultural drone applications. Operators proficient in adjusting sensors play a key role in leveraging the full potential of drone technology in agriculture.

- Identifying drone models and have the know-how of how to operate it

The skill of identifying and operating various drone models is a comprehensive competency that encompasses both theoretical knowledge and practical expertise. Operators with this skill can recognise and distinguish drone models based on specifications, features, and intended applications. Beyond identification, they possess in-depth understanding of the technical intricacies and limitations of each model. Proficient operators smoothly switch between drones, adapting their operation to specific task requirements. They excel in navigating controls, understanding navigation systems, and utilising unique functionalities. This skill is crucial in scenarios where different drones are optimised for specific applications, such as aerial photography, photogrammetry, surveying, or precision agriculture. Moreover, operators are knowledgeable about routine maintenance, troubleshooting, and basic repairs, ensuring optimal performance. This expertise empowers them to confidently manage diverse drone fleets, selecting the most suitable model for missions and ensuring smooth, efficient, and safe operations.

- Ensuring proper certification

Ensuring proper certification in the context of drone operations is a fundamental skill that emphasises compliance with regulatory requirements. Drone operators possessing this skill are adept at navigating the complex landscape of certifications and licenses necessary for legal and safe drone usage. They are knowledgeable about regional and national aviation authorities' regulations and stay updated on evolving standards. Operators with this skill guide their operations within the legal framework, obtaining appropriate certifications for different types of drone activities. This includes certifications for commercial use, special permissions for restricted airspace, and adherence to specific industry guidelines. They understand the importance of compliance in mitigating risks and ensuring public safety. Additionally, operators proficient in this skill assist organisations in obtaining necessary certifications, contributing to overall regulatory compliance. They play a crucial role in fostering a culture of responsible drone use, where adherence to certification requirements aligns with ethical and legal considerations. In essence, ensuring proper certification reflects a commitment to safety, legality, and professionalism in the realm of drone operations.

- Knowledge of technical terms

Understanding technical terms is fundamental for effective communication and collaboration in the drone industry. Drone operators with knowledge of technical terms can decipher complex

terminology related to aerial vehicles, sensors, and data processing. This proficiency allows them to engage in discussions with industry professionals, researchers, and regulatory authorities. Operators possessing this skill can articulate their ideas, report issues, and comprehend technical documentation accurately. It fosters a shared language within the drone community, facilitating efficient problem-solving and knowledge exchange. Whether discussing flight parameters, sensor specifications, or software configurations, operators with a grasp of technical terms can navigate the intricacies of drone technology with confidence. Moreover, this knowledge enhances safety and compliance, as operators can interpret and adhere to regulations, guidelines, and industry standards effectively. It promotes a culture of professionalism and ensures that drone operations are conducted with precision and adherence to best practices.

- Knowledge of how and what data to collect

Possessing a solid understanding of how and what data to collect is a pivotal skill for drone operators. This proficiency empowers operators to make informed decisions during drone missions, aligning data collection with specific objectives. Operators with this skill are adept at identifying the types of data relevant to their mission goals, whether it is aerial imagery, spatial information, or environmental parameters. Furthermore, they comprehend the technical details of data acquisition, ensuring high-quality and accurate results. This involves knowledge of camera settings, sensor calibration, and optimal flight paths to capture data effectively. Operators employing this skill also consider ethical considerations related to data privacy and security. They follow best practices for data handling and storage, ensuring compliance with regulations and safeguarding sensitive information. Overall, having a comprehensive knowledge of how and what data to collect enhances the effectiveness and ethical conduct of drone operations in agriculture.

- Knowledge of different camera types and their output

Understanding various camera types and their output is a crucial competence for drone operators. This proficiency enables operators to choose the most suitable camera for specific missions, ensuring optimal results in terms of image quality and data accuracy. Drone operators with this skill grasp the technical specifications of different cameras, including resolution, lens types, and sensor capabilities. They can tailor their camera selection based on mission requirements, considering factors such as spatial resolution, spectral sensitivity, and frame rate. Operators capable of capturing detailed aerial imagery for agricultural assessments, can adapt their camera/sensor choices to the unique demands of each task. Furthermore, these operators should also be adept at post-processing tasks, extracting valuable insights from the collected imagery. They understand how different cameras impact data analysis and interpretation, allowing them to generate meaningful and accurate results. Ultimately, the knowledge of different camera types and their output enhances the versatility of drone operations, enabling operators to address a wide range of applications with precision and efficiency.

- Knowledge of flight limitations

Understanding the flight limitations involves being cognizant of the constraints and restrictions that apply to drone operations. Drone operators with this expertise are familiar with factors such as maximum altitude, flight duration, and weather conditions that might impede safe and efficient drone flights. They possess the knowledge to assess and adhere to legal, technical, and environmental limitations, ensuring compliance with regulations and mitigating potential risks. Additionally, this skill encompasses the ability to make real-time decisions based on the specific circumstances of each flight, promoting safe and responsible drone operations within established boundaries.

- Identifying areas of operation

Identifying Areas of Operation entails the ability to determine suitable locations for drone flights based on various factors. Drone operators with this skill assess factors such as airspace regulations, geographical features, and potential safety hazards to identify optimal areas for drone operations. They consider the purpose of the flight, ensuring it aligns with legal and operational requirements. This skill involves selecting areas that maximise data collection efficiency while minimising risks and ensuring compliance with local regulations. By adeptly identifying appropriate operational zones, drone operators contribute to the safe and effective use of drones in diverse environments.

- Preparing and understanding a flight plan

Proficiency in preparing and understanding a flight plan is crucial for drone operators to conduct safe, efficient, and compliant aerial missions. This skill encompasses the ability to create a comprehensive plan that outlines the key elements of a drone operation. Operators skilled in preparing flight plans consider factors such as airspace restrictions, weather conditions, mission objectives, and regulatory requirements. They analyse the area of operation, identifying potential risks and constraints that may impact the drone's flight. Understanding the intricacies of airspace classifications and coordinating with relevant authorities ensures compliance with regulations. The skill involves utilising mapping tools and software to chart the optimal flight path, considering waypoints, altitude, and specific points of interest. Operators must also account for emergency procedures, contingency routes, and communication protocols in their plans. Beyond mere preparation, understanding the flight plan involves interpreting and adapting to real-time conditions during the mission. This adaptability is vital for addressing unforeseen challenges, ensuring the safety of the drone, other airspace users, and the surrounding environment. In essence, operators with proficiency in preparing and understanding flight plans demonstrate a comprehensive grasp of the entire drone operation process. This includes meticulous planning, adherence to regulations, and the ability to make informed decisions during the flight, ultimately contributing to the success and safety of drone missions.

- Check equipment conditions

Checking equipment conditions is a fundamental skill for drone operators, ensuring the proper functioning and reliability of all components before initiating any flight. This skill involves a

thorough examination of the drone and its associated equipment to identify any potential issues that could compromise safety or mission success. Proficient operators systematically inspect key elements, including the drone's frame, propellers, motors, and electronic components. They assess the integrity of the communication system, GPS modules, and other critical subsystems. Verifying battery health and connections is essential to prevent power-related incidents during flight. This skill extends beyond the drone itself to encompass the condition of the remote control, communication devices, and any additional equipment such as cameras or sensors. Attention to detail is crucial, as even minor defects or malfunctions can impact the drone's performance. Operators adept at checking equipment conditions understand the significance of following manufacturer guidelines for maintenance and inspection. They may conduct pre-flight checklists to ensure a systematic and comprehensive assessment, minimising the risk of equipment failure during operation. By routinely validating equipment conditions, operators contribute to safe and reliable drone operations. This proactive approach enhances the longevity of the equipment, minimises the likelihood of unexpected issues mid-flight, and underscores the operator's commitment to responsible and effective drone use.

- Avoiding possible hazards

Avoiding possible hazards is a critical skill for drone operators, emphasising proactive measures to mitigate risks and ensure safe flight operations. Operators proficient in this skill possess a keen awareness of potential hazards in the operating environment, ranging from physical obstacles and weather conditions to regulatory restrictions. Before each flight, they conduct thorough risk assessments, considering factors such as airspace classifications, proximity to airports, and the presence of people or property. Skilful hazard avoidance involves a comprehensive understanding of local regulations and adherence to airspace restrictions. Operators constantly monitor weather conditions and assess their impact on drone operations, recognising that wind, precipitation, or low visibility can pose significant risks. They also consider the potential for radio frequency interference and other technological challenges that might compromise communication with the drone. Beyond external factors, operators must anticipate potential malfunctions or issues with the drone itself, employing preventive measures and contingency plans. This skill requires continuous learning and staying informed about evolving regulations, technology updates, and best practices for safe drone operation. By avoiding possible hazards, operators contribute to the overall safety of the airspace and build a reputation for responsible and conscientious drone use. This skill is integral to maintaining compliance with aviation regulations, preventing accidents, and fostering public confidence in the responsible integration of drones in agriculture.

- Performing basic maintenance

Performing basic maintenance is an essential skill for drone operators, involving routine tasks to ensure the proper functioning and longevity of the drone. Operators proficient in this skill conduct regular pre-flight checks to inspect key components such as propellers, motors, batteries, and sensors. They examine the drone's physical integrity, looking for any signs of wear, damage, or loose connections. Battery health is a particular focus, with operators assessing capacity and voltage levels to guarantee optimal performance. Skilful maintenance

extends to firmware updates, where operators stay informed about the latest software releases and implement necessary updates to enhance the drone's capabilities and address any security vulnerabilities. Additionally, operators clean and calibrate sensors, cameras, and other equipment to maintain accurate data collection during flights. They handle storage and transportation with care, minimising exposure to extreme temperatures and ensuring the drone is securely packed. By consistently performing these maintenance tasks, operators contribute to the reliability and safety of their drones, reducing the risk of malfunctions and prolonging the overall lifespan of the equipment. This skill reflects a commitment to responsible drone ownership, promoting efficient operations in agriculture.

- Using specific data treatment software

Using specific data treatment software is a crucial skill for drone operators, emphasising the ability to process, analyse, and interpret data collected during drone missions. This skill involves proficiency in leveraging specialised software tools designed for tasks such as photogrammetry, remote sensing, and geographical information systems (GIS). Operators adept in this skill employ software like Pix4D, Agisoft Metashape, or other industry-standard platforms to transform raw imagery and sensor data into valuable insights. They create detailed maps, 3D models, and accurate measurements, contributing to applications in agriculture. This skill extends to data post-processing techniques, including image stitching, point cloud generation, and terrain modelling. Furthermore, operators utilise software features for quality control, ensuring the accuracy and reliability of the processed data. Mastery of specific data treatment software enhances the capabilities of drone operators, allowing them to generate actionable intelligence and support informed decision-making in diverse fields. This skill underscores the role of drones as advanced data collection tools, empowering professionals to extract meaningful information from aerial observations for improved efficiency and precision in agriculture.

- Identifying and interpret software reports

Identifying and interpreting software reports is a critical skill for drone operators, encompassing the ability to analyse and comprehend the output generated by specialised applications. This proficiency is particularly relevant when using data processing, mapping, or analysis software in drone operations. Drone operators skilled in this area can navigate through diverse software-generated reports, recognising key metrics, patterns, and anomalies within the data. Interpretation involves extracting meaningful insights, understanding graphical representations, and discerning trends or issues highlighted in the reports. This skill is essential for ensuring the accuracy and reliability of data, as operators can identify potential errors or irregularities that may impact the overall analysis. Additionally, operators may use these reports to communicate findings with stakeholders, making the skill valuable for effective collaboration and decision-making. Overall, the capacity to identify and interpret software reports enhances the operator's ability to derive actionable intelligence from drone-collected data, contributing to informed and data-driven decision processes.

- Identifying problems that arose and solve them

Identifying problems that arise and solving them is a crucial skill for drone operators, requiring a proactive approach to troubleshooting issues during drone operations. Operators proficient in this skill can quickly recognise and diagnose various challenges that may emerge, such as technical malfunctions, connectivity issues, or unexpected environmental factors. The ability to troubleshoot effectively ensures the smooth continuation of drone missions, minimising disruptions and potential data loss. This skill involves a combination of technical expertise, problem-solving acumen, and adaptability to address unforeseen circumstances. Drone operators with a strong capability in identifying and resolving problems contribute to the overall reliability and success of drone missions, promoting efficient and effective use of this technology in agriculture.

- Relate with stakeholders

Relating with stakeholders is an essential skill for drone operators, involving effective communication and collaboration with various parties involved in or impacted by drone operations. This skill extends beyond technical proficiency, emphasising interpersonal and relationship-building abilities. Drone operators proficient in relating with stakeholders can engage with clients, regulatory authorities, local communities, and other relevant parties to ensure transparent communication, address concerns, and foster positive relationships. This skill is vital for obtaining necessary permissions, maintaining community goodwill, and complying with regulatory requirements. Successful stakeholder engagement contributes to the responsible and ethical use of drones, aligning operations with community expectations and legal frameworks. Drone operators who excel in relating with stakeholders play a pivotal role in building trust, resolving conflicts, and promoting the broader acceptance and integration of drone technology in agriculture.

- Comply with regulations

Compliance with regulations is a fundamental skill for drone operators, involving a thorough understanding and adherence to legal frameworks governing drone operations. This skill encompasses staying informed about evolving regulations, obtaining necessary permits, and ensuring all drone activities align with local, national, and international laws. Drone operators proficient in compliance prioritise safety, privacy, and ethical considerations in their operations. This skill is crucial for maintaining legal standing, avoiding penalties, and fostering a positive regulatory environment for the broader drone industry. Operators who excel in complying with regulations contribute to the responsible and sustainable integration of drones in agriculture, demonstrating professionalism and accountability in their operations.

- Extract drone data

This competence involves the ability to efficiently collect, organise, and interpret information acquired during drone operations. Drone operators proficient in this skill can extract valuable data from various sources, such as sensors and cameras mounted on the drone. This process may include managing large datasets, employing data analysis tools, and generating meaningful insights. The skill extends to extracting relevant information for specific

applications, such as agricultural monitoring. Operators with expertise in extracting drone data contribute to informed decision-making, enabling stakeholders to derive actionable intelligence from drone-collected information.

- Transfer drone data

Transferring drone data encompasses the competence to securely move information obtained during drone missions from the unmanned aerial vehicle (UAV) to designated storage or processing systems. Drone operators proficient in this skill can effectively and safely transfer data collected by onboard sensors and cameras. This process may involve utilising wireless technologies, such as Wi-Fi or data cables, and adhering to established protocols for data integrity. Efficient transfer of drone data is crucial for subsequent analysis, reporting, and decision-making. Operators with this expertise ensure that the valuable information gathered by the drone is transmitted to the intended destination, facilitating further processing and utilisation by stakeholders.

Career Occupations & Opportunities (Vertical and lateral movement within or across related industries)

The agriculture industry is a wide one, with many different employment options ranging from hands-on farming to positions in specialised research. People can work their way up in the farming industry by starting out in manual labour positions like caring for animals or crops. This path may eventually lead to positions where you handle financial management and equipment maintenance, among other facets of agricultural operations.

There are other avenues for career progression in agriculture outside farming. Technical workers have the opportunity to go up the corporate ladder and take on executive or managing jobs. They may now oversee other technicians and take part in the strategic decision-making processes pertaining to technology and machines thanks to this vertical mobility.

The agriculture industry provides opportunity for both vertical and lateral mobility across adjacent disciplines. This might entail using one’s skills and knowledge from one field to another in order to move into a similar but distinct profession. For example, a person with farming expertise in a particular location may go into a position selling agricultural equipment and use their knowledge of farming requirements to guide their sales approach.

Because of new technology and the growing need for sustainable practices, the agriculture industry is always changing. New positions and areas of concentration have emerged as a result of this change, giving people the chance to move into these expanding fields. In an industry where innovation is being employed more and more to satisfy the needs of the global food supply and environmental concerns, this rapid change fosters continuous learning and adaptability, both of which are essential for professional advancement.

Both vertical and lateral motions may be seen in the career pathways and operational activities of drone professionals.

A drone operator may begin with simple piloting duties and work their way up to more sophisticated positions like managing drone systems, analysing data, or even strategically organising drone operations. This might entail managing drone fleets, supervising other drone operators, or deciding on drone deployment tactics.

Conversely, with respect to lateral mobility, professionals in this industry have the potential to operate in a range of industries due to the adaptability of drone technology. A drone operator with experience in agricultural applications may use their abilities to operate drones in other settings, such as urban planning, environmental monitoring, or emergency response.

Vertical mobility for drone experts in the agriculture industry might entail moving up from basic drone flying to positions including data analysis from drone-captured imagery or overseeing drone operations for major farming companies. A shift from agricultural uses to adjacent industries like environmental conservation, where drones are utilised for jobs like animal monitoring or habitat evaluation, is an example of lateral mobility.

The drone business is always changing due to new uses, regulatory changes, and technological breakthroughs. Drone professionals have several options for both vertical and lateral career development due to the industry's dynamic nature. Additionally, it promotes ongoing education and flexibility, both of which are essential for remaining current in this quickly developing sector.

Reflective Questioning Tools

As the agricultural sector undergoes significant transformation, driven by the integration of precision methods and drone technologies, professionals in the field face the dual task of reassessing and adapting their career paths. Two emerging occupational profiles have already been identified and analysed within this document. To advocate professionals in this journey, a set of established Reflective Questioning Tools is presented in this section which will set the ground for an online self-assessment tool that will support the e-Guide. Their application is tailored to fit the unique challenges of the agricultural sector. These tools facilitate a holistic self-assessment process, bridging personal introspection with professional aspirations. The goal is to help individuals build a clear roadmap and the necessary insights to make informed decisions, ensuring they remain at the forefront of agricultural advancements and opportunities.

SWOT Analysis and GROW Model

SWOT Analysis:

By analysing personal strengths and weaknesses, along with external opportunities and threats, individuals can create strategies for career growth, making the most of their strengths and opportunities while addressing weaknesses and countering threats.

GROW Model:

The GROW Model provides a structured framework that allows individuals to:

- Goal: Set clear, achievable career objectives.
- Reality: Understand their current situation, experience, and skills.
- Options: Explore possible career pathways or actions.
- Way Forward: Define concrete steps to achieve their goals.

By systematically assessing one's assets (strengths and goals) against the current realities and the broader landscape of opportunities and threats, individuals can gain a clear vision of potential career paths in the evolving agricultural drone sector.

Self-Assessment Questions

A number of self-assessment questions are provided to enable reflection on one's capabilities, mentality, and readiness for the dynamic field of agricultural drones. By rating their agreement with statements such as "I am able to describe my emotions, thoughts, and values" or "I am able to use career information effectively in planning my career", individuals can get insights into their readiness and areas that might require further development.

Regularly revisiting these questions allows for an evolving understanding of one's growth and development, aiding in the continuous refinement of career goals and strategies in the agricultural drone sector.

Advanced Reflective Tools for Career Decision-Making

- Empathy Maps

Understand the aspirations, challenges, and feelings of a professional in the desired role, aiding in aligning one's goals and preparation strategies.

- Journey Mapping

Visualise the career trajectory, identifying milestones, achievements, and challenges, to guide future career decisions.

- *5* Whys

A problem-solving technique, helping individuals uncover the deeper motivations or reasons behind their aspirations or challenges.

These tools can be instrumental in understanding the multifaceted nature of career aspirations, challenges, and pathways in the agriculture sector, especially when navigating the intricacies of precision agriculture and drone technology.

The agricultural sector is on the cusp of transformation, with precision agriculture and drone technologies at the forefront. For professionals and aspirants in this field, a systematic approach to self-assessment and career planning is imperative. The Reflective Questioning Tools, ranging from the foundational SWOT and GROW frameworks to advanced introspection tools like Empathy Maps, Journey Mapping, and the 5 Whys, offer a comprehensive toolkit to navigate this dynamic landscape confidently. By harnessing these tools, individuals can carve out meaningful, impactful careers in the future of agriculture.

Discussion

Figure 17 Adopted from www.unsplash.com Photo by Hrysh Chenko

The use of drones, or Unmanned Aerial Vehicles (UAVs), is transforming European agriculture, making farming more efficient and sustainable. Drones help farmers by gathering detailed data from above, allowing for better planning, cost savings, and potentially higher crop yields. This shift towards high-tech farming opens up new economic opportunities, including the export of technology and expertise. On a social level, drone technology is creating jobs in rural areas, which helps counteract the movement of people from countryside to cities and strengthens rural communities. These advancements are also vital for improving global food security by enabling farmers to produce more food more reliably.

The agricultural sector is moving towards a digital future, incorporating drones, the Internet of Things (IoT), big data, and artificial intelligence into everyday practices. This change requires cooperation between businesses, educational institutions, and governments to ensure drones are used safely and effectively. However, a significant challenge is the widespread lack of knowledge and skills necessary for this digital transformation. Collaborative efforts are essential to educate and train agricultural professionals in drone technology, attracting new talent to the sector and supporting the ongoing growth of agriculture.

This e-Guide and a Massive Open Online Course (MOOC) on sustainable agriculture using drones and digital tools are being developed to address these educational gaps, aiming to make the benefits of drone technology accessible to more people and promote a diverse and sustainable agricultural sector.

Conclusions

Figure 18 Adopted from www.pexels.com Photo by Ann H

This guide, produced by the AgroPro Project consortium, marks a significant advancement in agricultural innovation, blending precision farming and drone technology. It offers agricultural and drone professionals a comprehensive resource, outlining the new roles of Agricultural & Drone Professionals through surveys and interviews. The guide explores how precision farming and drones are reshaping agriculture, providing career guidance and support for job improvement. It outlines two main job roles according to ESCO standards: Drone Professionals and Agriculture Professionals, detailing the skills and knowledge needed for these careers. The guide encourages readers to engage in self-reflection and proactive career planning with tools like SWOT Analysis and the GROW Model, alongside Empathy Maps and Journey Mapping, to navigate the complexities of the agricultural sector.

Economically, drone technology boosts efficiency, reduces costs, and increases yields, aligning with sustainable agriculture goals. Socially, it generates new job opportunities in rural areas, curbing urban migration and enhancing food security. With the onset of Agriculture 4.0, a digital revolution in farming is underway. The guide advocates collaborative efforts to bridge the educational gap in drone technology, involving educational bodies, governments, and communities. It aims to prepare people working in EU agriculture for technological advancements, fostering a vibrant agricultural future. The e-Guide, in line with CEDEFOP's directives, acts as a navigator for professionals in the field of agriculture and drone technology, emphasising the importance of education and stakeholder involvement. In essence, this e-Guide is a practical tool for future agriculture professionals, highlighting emerging job profiles and offering career development tools in the realm of drone-enhanced agriculture.

Summary of key points and recommendations

The agricultural drone technology sector is rapidly growing, creating numerous career opportunities for skill enhancement and professional advancement. This transformation is driving efficiency, job creation, and significant economic impacts.

To support individuals in this evolving field, we recommend the career e-Guide, which aligns with CEDEFOP guidelines. It focuses on addressing skill gaps, aiding in career planning, and fostering innovation in agricultural drone usage. The guide features tools like SWOT analysis and the GROW model for personal development.

For those looking to further navigate the agricultural drone technology landscape, combining this guidebook with the e-Guide is highly advised. They detail emerging job roles due to technological progress, while targeting agricultural professionals aiming for career growth amid these developments. Together, they serve to bridge the knowledge and skills gap, highlight new professional profiles, and define learning objectives. They are comprehensive resources for creating educational content, boosting self-directed career exploration, and guiding learners towards enhancing their qualifications.

The e-Guide, beneficial for individuals and career advisors alike, offers insights into the agricultural technology field, unveils drone-related career opportunities, and provides access to a MOOC on sustainable agriculture using UAVs. This combination is a streamlined resource for strategic career progression in the fast-paced world of agricultural drones.

Appendices

SWOT Analysis Questions

Strengths:

- What are your primary strengths in the field of Agricultural Drone Technologies?
- What skills or qualifications set you apart from others in your industry?
- In what areas of the Agricultural Drone Professionals industry do you feel most confident?

Weaknesses:

- Are there any skills or knowledge areas in the Agricultural Drone Professionals industry where you feel you lack or need improvement?
- What challenges have you encountered in your current role or while pursuing your learning path?
- In which areas of drone technology or its application in agriculture do you feel the least confident?

Opportunities:

- What new roles or career paths in the Agricultural Drone Professionals industry excite you the most?
- How do you envision the future of drone technology in agriculture, and where do you see yourself in that landscape?
- Are there any emerging trends, training, or courses that could enhance your expertise or career prospects?

Threats:

- What external factors or technological shifts could impact your career or learning path negatively?
- Are there any competitive forces or challenges in the drone industry that concern you?
- What regulatory or ethical concerns do you perceive as potential obstacles in the Agricultural Drone Professionals industry?

GROW Model Questions

Goal:

- What specific career or learning objective would you like to achieve within the Agricultural Drone Professionals industry?
- In what timeframe are you hoping to accomplish this goal?
- How will achieving this goal benefit you personally and professionally?

Reality:

- Where do you currently stand concerning your set goal?
- What skills, knowledge, and resources do you already possess that will aid in achieving this goal?
- What challenges or obstacles are you currently facing in reaching your goal?

Options:

- What potential paths or strategies have you identified that could lead you towards your goal?
- Are there any alternative goals or pathways you've considered?
- Who in your network or within the industry could provide guidance, mentorship, or collaboration opportunities to help you explore these options?

Way Forward:

- Based on your reflections, what immediate steps will you take to move closer to your goal?
- How will you measure your progress along the way?

- What support or resources will you seek to ensure you remain on track and overcome any challenges that arise?

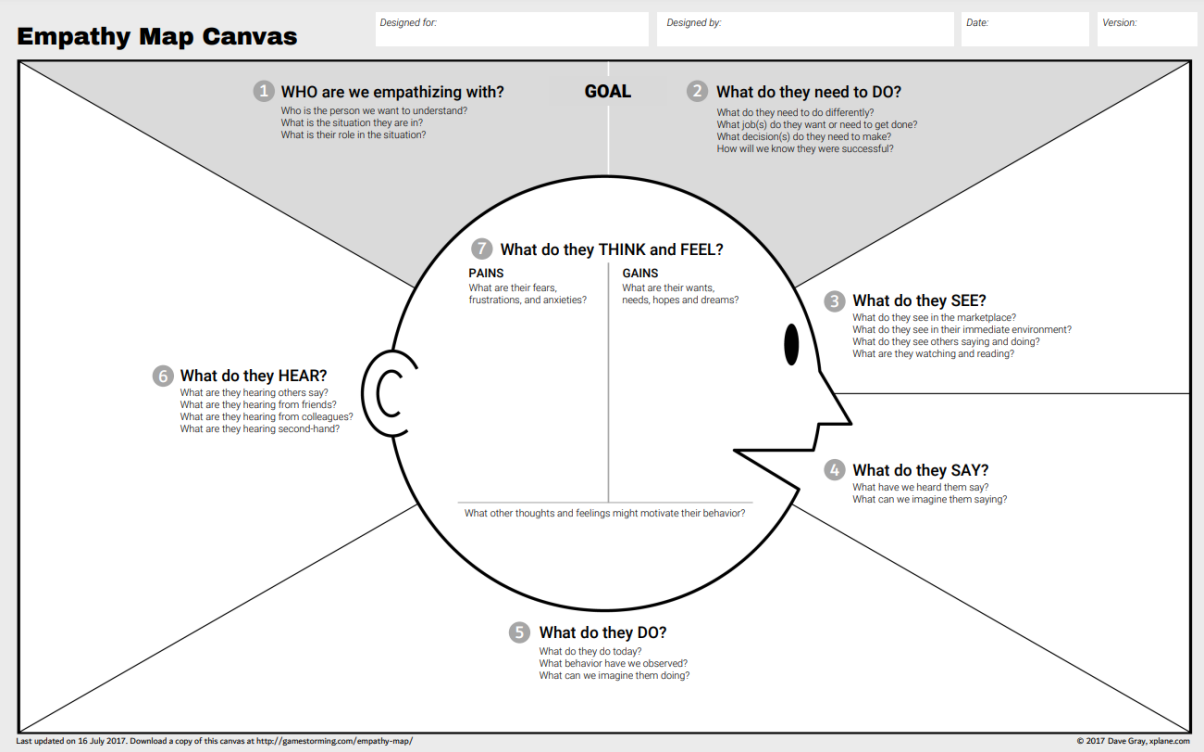
Self-assessment Questions

Statement	To a small extent	To some extent	To a large extent
I have comprehensive knowledge of the latest drone technologies utilised in agriculture.			
I am confident in my ability to troubleshoot issues related to agricultural drones.			
I can identify the legal and ethical implications related to drone usage in agriculture.			
I am well-versed with the safety protocols for drone operations in agricultural settings.			
I can adapt to new drone technology trends that emerge in the agricultural sector.			
My knowledge of drone mapping and imaging is sufficient for effective agricultural applications.			
I understand the environmental impact and sustainability aspects of using drones in agriculture.			
I can effectively communicate the benefits of drone technology to non-tech-savvy stakeholders.			
I feel equipped to train others on the use and maintenance of agricultural drones.			
I am proactive in seeking out continuous learning opportunities in the field of agricultural drones.			
I believe I can influence the future direction of drone usage in agriculture.			
I am confident in my ability to collaborate with manufacturers and developers in the drone industry.			
I see the potential for integrating drone technology with other advanced tech (like AI, IoT) in agriculture.			
I am prepared to face challenges like data privacy when collecting data using agricultural drones.			
I can effectively balance the economic benefits and costs associated with agricultural drone use.			
I am familiar with the policies and regulations of UAVs in different European countries.			
I see myself as an advocate for the ethical and responsible use of drones in agriculture.			

I am aware of the current gaps in the market concerning agricultural drone solutions.			
I can envisage innovations in drone technology that could revolutionise farming methods.			
I am comfortable networking with a diverse range of professionals in the drone-agriculture nexus.			

Table 8 Self-Assessment Questions

Empathy Map Template



Adopted by: https://gamestorming.com/empathy-map-canvas-006/

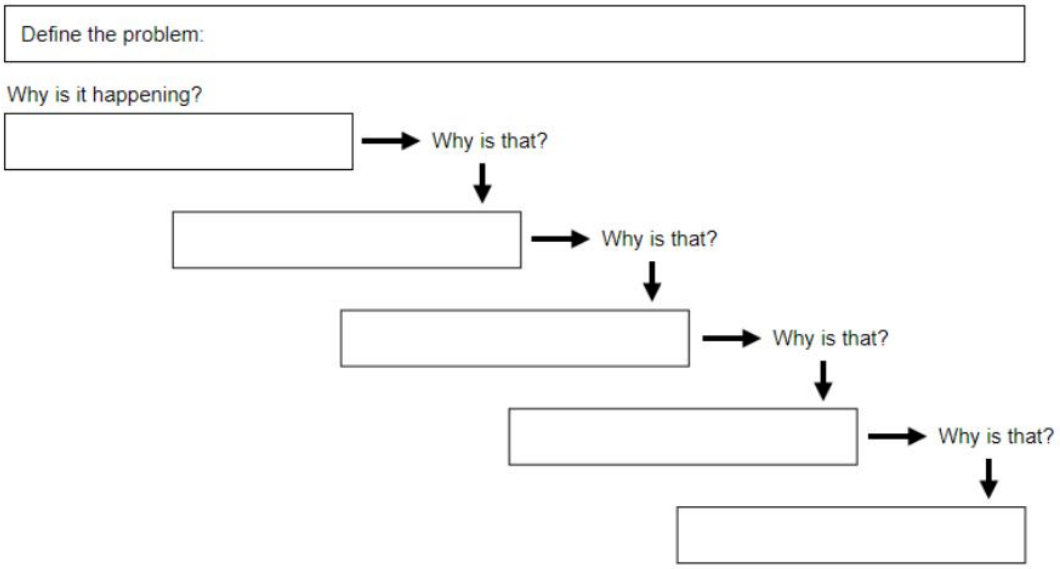
Journey Mapping - 9-Window Diagram

Past High-Level	**Present High-Level**	**Future High-Level**
Past Mid-Level	**Present Mid-Level**	**Future Mid-Level**
Past Entry-Level	**Present Entry-Level**	**Future Entry-Level**

Instructions for Each Box:

- Past High-Level: Reflect on any prior roles or experiences where you operated at a high level. What skills and knowledge did you gain?
- Present High-Level: If you're currently in a high-level role, document your current responsibilities, successes, and challenges.
- Future High-Level: Envision your desired future high-level role. What will it entail, and what skills or experiences will you need to get there?
- Past Mid-Level: Reflect on your mid-career stage. List out roles, significant achievements, and any pivot moments that influenced your journey.
- Present Mid-Level: If you're at the mid-point of your career, jot down current roles, projects, and any ongoing professional development efforts.
- Future Mid-Level: Think about potential mid-level positions you might want to explore in the future, and what they might require.
- Past Entry-Level: Think back to the start of your career. What roles did you hold, and what were your foundational learnings?
- Present Entry-Level: If you're in an entry-level role, describe your day-to-day tasks, responsibilities, and what you're hoping to learn.
- Future Entry-Level: Consider any entry-level experiences or roles you might still want to delve into in the future, even if for gaining a broader perspective.

5 Whys Template



Adopted by: https://online.visual-paradigm.com/knowledge/root-cause-analysis/root-cause-analysis-5-whys-technique/

Example:

Initial Problem: My uncertainty regarding my future occupation in the agricultural sector, especially concerning new technology and precision agriculture.

- Why?: Until now, there is no relevant knowledge about future occupational profiles in this domain.
- Why?: I haven't accessed or been exposed to comprehensive resources that elucidate the specifics of these emerging roles.
- Why?: Until now, there hasn't been a unified platform or tool that gathers all relevant information and guidance tailored to the agricultural drone sector.
- Why?: Traditional career guidance tools and resources have not evolved at the pace of technological advancements in the agricultural sector, creating a knowledge gap.
- Why?: The integration of modern technology in agriculture is still relatively new, and many institutions or platforms might not have fully recognised the urgency or necessity to develop updated guidance.

Root Cause: A combination of the rapid pace of technological advancements in agriculture, lag in updates of career guidance resources, and the prior absence of specialised tools like an e-Guide and a MOOC to cater to these changes.

References

1. European Centre for the Development of Vocational Training, ed. *Handbook of ICT Practices for Guidance and Career Development*. Publications Office of the European Union; 2018. doi:10.2801/368695

2. Scott BI, I. Andritsos K. A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe. *Air Space Law*. 2023;48(Issue 3):273-296. doi:10.54648/AILA2023041

3. Vuorikari R, Kluzer S, Punie Y. DigComp 2.2, The Digital Competence Framework for Citizens: With New Examples of Knowledge, Skills and Attitudes. Publications Office of the European Union; 2022.

4. European Commission. Directorate General for Employment, Social Affairs and Inclusion. *ESCO Handbook: European Skills, Competences, Qualifications and Occupations.* Publications Office; 2017. Accessed January 26, 2024. https://data.europa.eu/doi/10.2767/934956