SKILLING, UPSKILLING, RESKILLING

IN THE FUTURE AIR TRANSPORT

D2.2 Study pathways: Skilling, Upskilling and Reskilling

(28/06/2021)

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SKILLING, UPSKILLING, RESKILLING IN THE FUTURE AIR TRANSPORT

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List of Acronyms

Acronyms List	
ADS-B	Automatic Dependent Surveillance-Broadcast
AGCAS	Automatic Ground Collision Avoidance System
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Services
BVLOS	Beyond Visual Line of Sight
CAS	Calibrated Airspeed
COMINT	Communications Intelligence
CPDLC	Controller Pilot Data Link Communications
CG	Center of Gravity
DOP	Dilution of Precision
EAS	Equivalent Airspeed
EASA	European Union Aviation Safety Agency
EBT	Evidence Based Training

EICAS	Engine Indicating and Crew Alerting System
ELINT	Electronic Intelligence
ERP	Emergency Response Plan
EU	European Union
FPV	First Person View
GCS	Ground Control Station
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GS	Ground Speed
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMSAFE	Illness, Medication, Stress, Alcohol, Fatigue, Emotion
METAR	Meteorological Aerodrome Report (Aviaton Routine Weather Report)
MEUH	Meteorology, Environment, UAS, Human
ND	Navigation Display
NOTAM	Notice to Airmen
PDRA	Predefined Risk Assessment
PFD	Primary Flight Display
QFE	Atmospheric pressure at aerodrome elevation (or at runway threshold)
QNE	Standard altimeter setting (29,92'' Hg or 1013,25 hPa or 1013,25 mbar)
QNH	Altimeter sub-scale setting to obtain elevation when on the ground

RC	Radio Controlled
R&D	Research and Development
RP	Remote Pilot
RPAS	Remotely Piloted Aircraft System
SIGWX	Significant Weather
SOP	Standard Operating Procedures
SORA	Specific Operations Risk Assessment
SPECI	Special Meteorological Aerodrome Report (Aerodrome Special Meteorological Report)
SPO	Single Pilot Operations
SSR	Secondary Surveillance Radar
STS	Standard Scenario
TAF	Terminal Aerodrome Forecast
TAS	True Airspeed
TCAS	Traffic Collision Avoidance System
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
UTM	Unmanned Traffic Management
VET	Vocational Education and Training
VFR	Visual Flight Rules
VLOS	Visual Line of Sight

Executive summary

The main purpose of this document is to present the results and conclusions of Task 2.3: Study Pathways: Skilling, Upskilling, and Reskilling.

The aim of Task 2.3 was to design different study pathways for the different personas identified in T2.2 that will enable the acquisition of the essential skills needed in future scenarios. With that purpose twelve study pathways were designed following the personas developed in T2.2, which was the main source to develop the study pathways complemented by the development of a competence matrix filled by the project partners taking into consideration the focus group inputs.

The Study Pathways developed contain a: 1) Formal training Section, which explored the required training both theoretical and practical that will be essential to become professional in Europe and 2) Competence-based Section, the skills matrix which explore in depth the most important technical and transversal skills identified in T2.2. Personas.

The Skill-UP Study Pathways will be used to feed the next steps of the project, specifically WP3: Implementation of training and work-based learning, since in the competence matrix we specified the knowledge, skill, and preliminary training topics.

In the same way as the other Skill-UP results, the Study Pathways will be integrated into the Knowledge Center (WP5), an e-learning platform that Skill-UP will develop in the next phase of the project.

To achieve this, Study Pathways will be graphically implemented, in compliance with the graphical representations of future aviation scenarios and personas. That version will be designed as a pathway with steps to guide the person in the process of skilling, upskilling, or reskilling.

1 Overview

1.1 Project overview

The skill-UP project aims to define the knowledge, skills, and competencies required by the current and future workforce of the air transport industry so that the educational and training programs can be better aligned to the requirements of different occupational profiles. The project looks at four occupational profiles: air traffic controllers, pilots, airport operators, and drone operators.

The project seeks to develop initial and continuing VET training programs based on suitable and innovative teaching and training methodologies and study pathways to aid in the skilling, upskilling, and reskilling of the future workforce of the air transport sector. The skills and knowledge required by the future workforce will change, mainly because of an increase in digitization, automation, and advancement in artificial intelligence. New competencies will become essential, amongst which are: the ability to work with data to perform descriptive diagnostics, predictive and prescriptive tasks; increased ICT knowledge, including multimodal interaction with advanced HMIs, automation, and robotics; and teamwork and communication skills, in scenarios where the team would be composed of both humans and advanced automation.

The skill-UP project aims to identify such new required competencies and address the training needs required to address the current gaps in skills and knowledge.

1.2 Purpose and scope of the document

The main purpose of this document is to present the results and conclusions of Task 2.3 – *Study Pathways: Skilling, Upskilling, and Reskilling.* The aim of the Study Pathways is to complement the future job profiles developed through the Skill-UP personas, by specifying the knowledge, skills, and abilities associated with each professional profile. They attempt to describe not only the formal training that will be required to become a professional (knowledge) but also the skills and abilities necessary to be a successful professional.

In this document we describe in detail the formal training (topics and specific knowledge) and competencies (theoretical and practical skills) someone needs to develop under the process of skilling, upskilling, and reskilling. Following the development of the personas, we present twelve study pathways, which will be further transformed into lighter representations to be used by user profiles in order to understand the steps and prioritize their own learning pathway.

1.3 Deliverable structure

This document is divided into three parts.

Section 1 - *Overview* - gives a brief overview of the Skill-UP Project and defines the purpose and structure of the deliverable.

Section 2 – ***Errore. L'origine riferimento non è stata trovata.*** - describes Task 2.3 of the Skill-UP Project which aims an enabling the acquisition of the essential skills needed in future scenarios. In this section, we will describe twelve skill-UP study pathways, the result of each partner's research and consultation.

Section 3 - ***Errore. L'origine riferimento non è stata trovata.*** – describes how the Study Pathways developed through Task 2.3 (as described in Section 2) will be used to feed the next steps of the project, namely the VET training programs and assessment portfolios and their integration in the Knowledge Center.

2 Study Pathways

In order to build the Skill-UP study pathways, it was necessary to firstly understand what a study pathway is and how to properly build it. So, the first step was a preliminary research on the study pathway's usual structure and content The second step, was the process of adapting the "traditional" study pathway to the Skill-UP goal and context: skills development. In the third step, the goal was to develop a common structure to all professional profiles study pathways, to be filled by all the partners. Finally, all the study pathways were collected and reviewed to integrate the present deliverable.

2.1 The Skill-Up Study Pathways Development Process

2.1.1 The Study Pathway: Definition and Examples

A study pathway is a concept mainly used by Universities or VET providers to represent the steps or path the leaner need to follow in order to enrol in a specific course/degree and/or become a determined professional. Depending on the goal and type of institution the study pathway can present in-depth the several steps a learner needs to follow to achieve the goal or can explore the distinct paths available to achieve the goal (Figure 1).

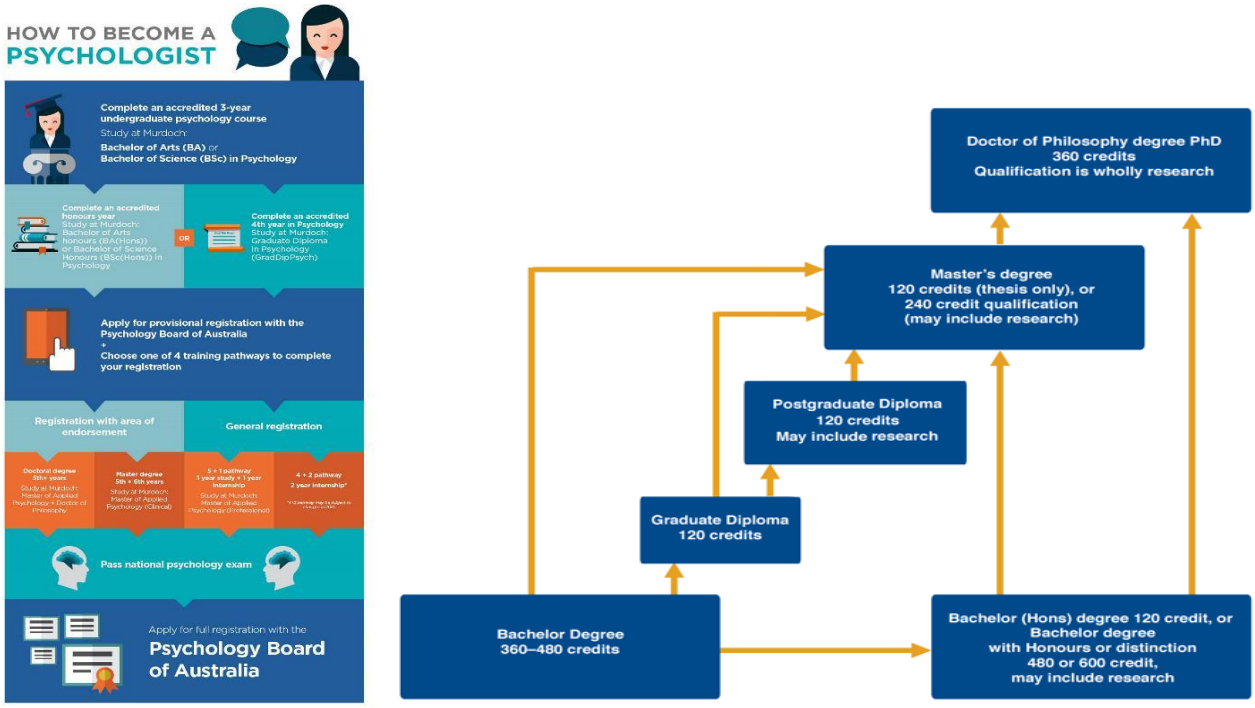

Figure 1: Examples of Study Pathways.

Although study pathways can assume distinct structures, we can identify common aspects:

1) An explicit final goal.
2) A path to achieve the goal, that highlights the steps considering the causality of the steps and temporal progression.

Finally, is necessary to distinguish the study pathway from similar terms used on vocational and education training, for example, a "learning pathway". While the study pathway presents the usual steps and available paths for every learner (although we can find some exceptions of study pathways developed for specific target groups, for example, international students), the learning pathway presents the specific courses, academic programs, and learning experiences that individual students complete as they progress in their education, focusing on the individual and personalized learning experience of the learner (https://www.edglossary.org/learning-pathway/).

2.1.2 The Study Pathway Added Value

Although the study pathways can assume distinct formats due to their lack of a common definition, they are a useful tool, special to individuals:

- in the beginning of their educational and professional path;
- who are still trying to understand and choose a career path.

2.2 The structure of the Skill-UP Study Pathways

The Skill-UP study pathways follow the traditional study pathways, by having:

1) Explicit goal: Each study pathway targets a specific professional profile (ATC, Airport Agents, RPA, and Commercial Pilots) with the goal of skilling or reskilling or upskilling.
2) Path: In this case, including the big steps someone needs to follow to successfully do the process of skilling, upskilling, and reskilling. The step-by-step approach will be developed on the next steps with the development of the user-friendly representations.

However, and due to the Skill-UP project context, the Skill-UP study pathways will adapt the traditional structure to the competence-based approach of the project. Since the study pathways are mainly used for public or private vocational and educational training providers, it usually focuses on the major steps: degrees, master's, licenses, on-site-training, exams, etc. The Skill-UP study pathways will incorporate the "traditional" part in a first section named "Formal training". The second section, will explore the competencies which should follow the formal training development and acquisition, named "Competency-based".

To develop both sections, three outputs from previous tasks were taken as input to design the, as follows (Figure 2):

- Personas (T2.2) and Deliverable (D2.1) [2];
- Experts advice collected on the National focus group (T2.1);
- ICAO and other official training sources [1].

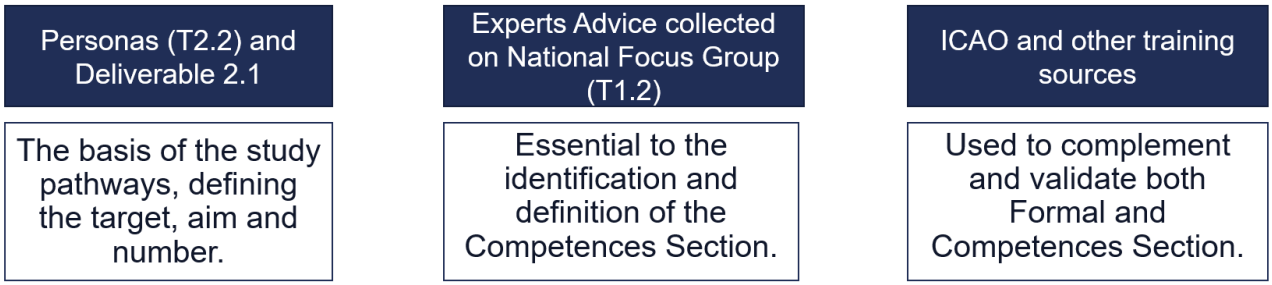

Figure 2: Sources for the Skill-UP Study Pathways.

To complement the above materials, project partners filled in a skill matrix on the Competency Section, which defined the theoretical and practical knowledge associated, a useful information for further training development on T3.3.

The above sources of information will substitute the workshop explained in the project description, which aimed at identifying the skills that will be essential in the future labour market and the theoretical and practical knowledge required.

2.3 The template for the Skill-UP Study Pathways

As previously mentioned, the Skill-UP study pathways have two main sections:

1) Formal Training: Dedicated to the future training that will be required both for new entrants who want to acquire the foundation knowledge and skills needed for a specific career in

the aviation sector (skilling) and experienced professionals and practitioners who wish to acquire more advanced knowledge/skills to progress within the aviation sector (upskilling/reskilling).

2) Competences: Correspond to the Skill Matrix, filled in detail by the partners in order to explore preliminary training topics to the WP3.

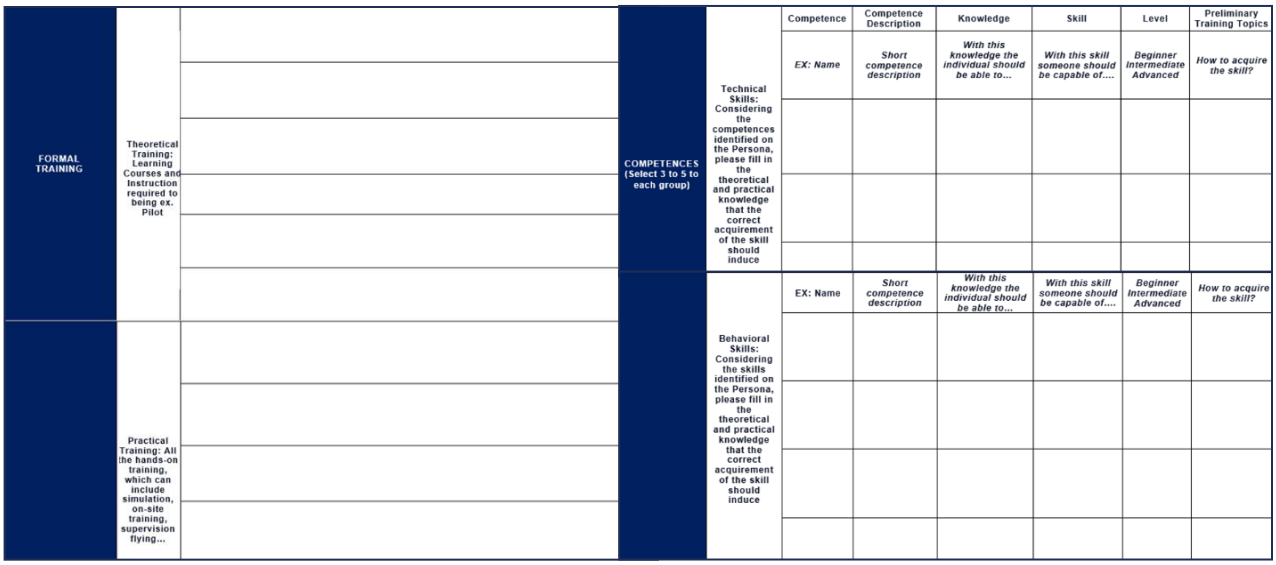

Figure 3: The template for the Skill-Up Study Pathways.

2.4 The Skill-UP Study Pathways

Since the T2.3 aim at designing different study pathways for the different personas identified in T2.2 in order to enable the acquisition of the essential skills needed in the future scenarios, a total of 12 distinct study pathways were produced, Figure 4 details the list of the Skill-UP Study Pathways, showing for each the operational environment and the training context.

Operational environment	STUDY PATHWAYS	THE SKILL-UP STUDY PATHWAYS	Training Context
Single/Multiple rTower operations	SP #1	**New entrant rTower ATCO**	Skilling
	SP #2	**Professional Tower ATCO** (who has to become rTower controller)	Reskilling of a professional Tower ATCO
	SP #3	**On the job rTower trainer**	Upskilling of a professional trainer
Single pilot operations	SP #4	**New entrant single pilot**	Skilling
	SP #5	**Professional commercial pilot** (who has to become single pilot onboard)	Reskilling of a professional pilot
	SP #6	**New entrant ground pilot**	Skilling
	SP #7	**Professional commercial pilot** (who has to become ground pilot)	Reskilling of a professional pilot
Virtual check-in operations	SP #8	**New entrant check-in agent**	Skilling
	SP #9	**Professional check-in agent**	Upskilling and Reskilling of a professional check-in agent
U-Space operations	SP #10	**New entrant remote pilot**	Skilling
	SP #11	**Professional remote pilot on Open Category**	Upskilling of a professional remote pilot
	SP #12	**Professional remote pilot in specific category**	Reskiliing of a professional remote pilot

Figure 4: The List of Skill-Up Study Pathways.

2.4.1 ATC Study Pathways

Considering the four personas developed for the ATC, three study pathways were developed:

- New Entrant rTower ATCO: Skilling
- Professional Tower ATCO: Reskilling
- On the job rTower Trainer: Upskilling

Each study pathway was designed considering the personas context and pre-existence knowledge and skills, which are the starting point assumption from building the study pathway focusing on the skilling, reskilling, and upskilling for the future scenarios.

Finally, in order to let explore in more detail the study pathway, the reader can find a link in each Study Pathway Figure Legend that leads to the study pathway independent document.

2.4.1.1 New Entrant rTower ATCO: Skilling

The Patricia ATC Persona was developed to represent the professional profile of a new entrant remote tower controller, namely a student who has just received his initial remote tower controller training and is supposed to start working as a remote tower controller in the remote tower of her own city. Patricia was imagined as an early adopter of new technologies and very keen on discovering new systems and applications. Her training needs are expected to deal with the basic use of the remote tower systems, as for the technical skills, and with service orientation, teamwork, and decision making among the transversal skills.

The trainee shall carry out the following tasks:

1. Separate aircraft and vehicles operating in the manoeuvring area.
2. Separate aircraft in the circuit, and from arriving and departing aircraft.
3. Select runway in use.
4. Issue IFR clearances for departing aircraft and ensure correct readbacks.
5. Manage inbound and outbound IFR aircraft.
6. Issue inbound and outbound Visual Flight Rules (VFR) clearances to aircraft.
7. Integrate VFR arrivals into the aerodrome traffic circuit.
8. Integrate VFR departures within the traffic flow.
9. Issue flight and aerodrome information.
10. Issue traffic information.
11. Coordinate the movement of traffic with approach/area control and relevant airport services.
12. Monitor flight data displays and ensure that they are kept up-to-date
13. Transfer control and communication of aircraft to other sectors

NEW ENTRANT RTOWER ATCO: Skilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Aviation law	-Atco licensing/certificate of competence -Rules and regulations (reporting, airspace class, airspace structure…) -ATS safety management (just culture, occurrence reports, safety investigation…)
	Air traffic management	-Provision of services: Aerodrome control service; Flight Information Service; Alerting service; ATS system capacity and air traffic flow management -Communication -ATC clearances and ATC instructions -Coordination (coordination procedures, tools and methods for coordination, …) -Altimetry and level allocation (terrain clearance -Separations: Separation between departing aircraft; Separation of departing aircraft from arriving aircraft; Separation of landing aircraft and preceding landing or departing aircraft; Time-based wake turbulence longitudinal separation; Reduced separation minima -Airborne and ground-based safety nets -Data display -Operational environment (simulated): Obtain information concerning the operational environment Ensure the integrity of the operational environment; Verification of the currency of operational procedures; Handover-takeover -Provision of an aerodrome control service: Responsibility for the provision; Traffic management process (Information gathering, observation, traffic projection, traffic monitoring, adaptability and follow up); Aeronautical ground lights; Information to aircraft by aerodrome control tower; Runway in use; Control of aerodrome traffic; Control of airborne traffic; Manage departing aircraft; Manage arriving aircraft; Manage SVFR traffic; Low visibility operations; Aerodrome control service with advanced system support (AMAN, DMAN, automated conflicts/incursions tools, alarms and resolution advisory tools, automated assistance for surface movement planning and routing, enhanced vision technology in low visibility for controllers…)
	Meteorology	-Meteorological phenomena (sources, instruments and other sources of meteorological data)
	Aircraft Navigation	-Maps and aeronautical charts -Instrument navigation (Navigation systems, stabilized approach, instrument departures and arrivals, Satellite-based systems, PBN…) -Aircraft instruments -Aircraft categories -Factors affecting aircraft performance (take off factors, climb factors, final approach and landing factors, economic factors, environmental factors…) -Aircraft data (Recognition of aircraft types, performance data…)
	Human factors	-Information processing -Factors affecting health and well-being (Fatigue, Stress,…) -Threat and error management -Teamwork -Systems
	Equipment and systems	-Voice communications -Automation in ATS -Controller working position -Future equipment -Equipment and systems limitations and degradation
	Professional environment	-Familiarization on the field -Airspace users -Provision of services and user requirements Environmental protection
	Abnormal and emergency situations	-Abnormal and emergency situations (abes) -Skills improvement (Communication effectiveness, avoidance of mental overload, Air / ground cooperation…) -Procedures for abnormal and emergency situations (Application of procedures for ABES, radio failure, unlawful interference and aircraft bomb threat, strayed or unidentified aircraft, runway incursion, interception of civil aircraft…)
	Aerodromes	-Aerodrome data, layout and coordination -Movement area -Obstacles -Miscellaneous equipment
	Introduction to remote aerodrome air traffic services	-Operating environment -Human factors aspects -Procedures for degraded modes
	Virtual technology	-Basic use of a panoramic display & transition of ambient sound -Basic use of pan tilt and zoom cameras -Basic automatic identification and tracking of aircraft -Basic use of facility to highlight certain objects / information (augment reality) -Basic use of visual Enhancement Technology

	Main Topic	**Description of content**
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying…	Demonstration	The process by which the OJTI controls the traffic whilst showing the student the correct method(s) of executing control tasks or procedures and simultaneously explaining his actions Demonstrate& Explain: -Use language understood by student -Check comprehension / understanding -Be precise Emphasise safety features -Before, during, after -Cause and effect Involve student actively -Testing questions
	Talk Through	The OJTI retains R/T and student is required to make executive decisions and tell OJTI exactly what to do with the aircraft and when. - Require the student to tell you exactly what to do with the aircraft, and when - Student to observe situation first, make executive decisions - If decisions sound and valid, transmit - tIf not, transmit correct instruction, then discuss his decision - Often follows the demonstration phase, precedes monitoring
	Monitoring	Monitor the trainee's thought processes and working practices with a view to giving objective and accurate feedback. When the Student able to make executive decisions, and to communicate them on the R/T With note taking from the trainer. And "aide memoire" - What is the student doing well? - Why is it working successfully for the student? - How is it possible to build on this success? - What is not going so well or what is going wrong? - What could be a possible reason? - How could this have been avoided? - What should be done in future to avoid repetition?
	Debriefing	- To identify the trainee's strengths and weaknesses - To reinforce what the trainee has learnt - To aid a trainee's self-analysis - To discuss and determine any remedial training needs.

COMPETENCES (select 3 to 5 to each group)					
Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Traffic and Capacity management	Ensure a safe, orderly and efficient traffic flow and provide essential information on environment and potentially hazardous situations.	-Manage the traffic situation. -Achieve optimal operational. -Performance. -Disseminate flight information. -Inform pilots of essential traffic and weather information.	-Manages arriving, departing traffic using prescribed procedures. -Takes aircraft performance into account when issuing clearances and instructions. -Uses a variety of techniques to effectively manage the traffic (e.g. speed control, vectoring, traffic sequencing, assigning climb/descent rate). -Takes action when appropriate to ensure that demand does not exceed sector capacity. -Inform pilots of essential traffic and weather information.	Beginner: can manage traffic but is still limited in the variety of techniques available for vectoring/sequencing... may not yet have routine behaviours. Is not yet able to anticipate and apply appropriate actions to ensure sector capacity is not exceeded. Advanced: demonstrate skills to apply all relevant methods for the best management of arriving and departure traffic. Taking aircraft performance into account is routine and sector/rwy capacity is never exceeded. Appropriate measures to anticipate are always taken.	-Initial training: learn prescribed procedures. Learn potential separation techniques, aircraft performance and factors impacting traffic management. -Start to train on simulator with easy and standard scenario. Appreciate the application of procedure in practice. Received feedback on action and repeat scenario on simulator to start developing skills. -Unit training: For initial training for an aerodrome control rating: The trainee will be able to demonstrate an integrated performance of all the competencies under the following conditions: a) within the simulated aerodrome environment described in Unit Operations Manual; b) with all levels of traffic up to a maximum of thirty -five aircraft/hour; c) with a maximum of fifteen aircraft being simultaneously controlled and a maximum of three active conflicts to be resolved at any one time; d) without assistance from the instructor; and e) using all the tools available in the simulated environment.
Criteria approcation	Applies sequence criteria correctly.	The trainee can recognise all the conflicts in time during all traffic complexities, solve them and maintain at least the required minimum separation. The trainee provides separation of landing aircraft and preceding landing or departing aircraft with time-based wake turbulence longitudinal separation. in establishing the departure and arrival sequences.	-The sequence criteria need to be a skill-based behaviour while maintaining separation. -Separation is maintained in all situations for landing and departing aircraft.	Beginner: trainee still has difficulty recognising and solving all conflicts in time, using the required minima, as he still must get acquainted with the live environment. Intermediate: trainee can recognise all conflicts in time during low and moderate complexity traffic, solve them and maintain at least the required minimum separation.	Initial training: A minimum of thirty formative assessments have been completed. The candidate is ready to undertake summative assessment when four formative assessments indicate that the candidate is demonstrating an integrated and consistent performance. ICAO doc 10056). Unit training: n the case of unit training, this is a reference to the local operating documentation e.g. National Manual of ATS, local operating procedures, letters of agreement etc. In the case of initial training, the local operating documentation may not apply at this stage but would be introduced later at the unit training phase. For the purposes of the training specification, the sources documents should be listed that will be used for developing these procedures e.g. ICAO Doc 4444 and/or National Manual of ATS.
Monitoring	Switches in time from monitoring to ensured separation	The switch from monitoring to a positive control action during all traffic complexities is timely and correct, resulting in a continuous safe control of traffic. The trainee is able to pay attention to all traffic and apply control actions in time showing consistency in all his decisions.	It is essential to be able to monitor execution of action in addition to the monitoring of aircraft and identification of potential conflicts or problem. The switch on time from monitoring to ensured separation is an essential skill for a safe and efficient flow of traffic/ throughput.	The switch from monitoring to a positive control action during low and moderate traffic complexity is timely and correct, resulting in a continuous safe control of traffic. During high traffic complexity the trainee may-find it difficult to pay attention to all traffic and apply control actions in time.	Unit training: Observe experts doing the job on the field. Manage traffic being coached and assessed by expert. Develop skills and routine by doing the job under supervision. Formative assessments are a part of the learning process. Instructors provide feedback to the trainee on how they are progressing toward the interim or final competency standard. This type of assessment enables the trainee to progressively build on competencies already acquired and should aid learning by identifying gaps as learning opportunities.
Terrain clearance	Ensures terrain clearance	The trainee can provide planning, coordination, and control actions appropriate to the rules for minimum safe height and terrain clearance. The trainee responds to available ground-based safety nets warnings.	Appreciate areas of responsibility. Control zone, traffic circuit, manoeuvring area, movement area, vicinity Maintain separation between aircraft and terrain	Provide planning, coordination, and control actions appropriate to the rules for minimum safe height and terrain clearance.	Content support: Terrain clearance dimensions, minimum safe altitudes, transition level, minimum flight level, minimum sector altitude
Safety buffers	Builds in Safety buffers.	The trainee can recognise conflicts in time and can apply adequate safety buffers during all traffic complexities consistently.	-Issues hazard and safety alerts to the flight crews when necessary. -Provides assistance and acts, when necessary, to ensure safety of aircraft in area of responsibility. -Perseveres in working through problems without impacting safety. -Increases safety margins when deemed necessary.	Beginner: trainee still has difficulty recognising and solving all conflicts in time, using the required minima, as he still has to get acquainted to the live environment. Therefore safety buffers are not always applied. Intermediate: The trainee can recognise conflicts in lime and can apply adequate safety buffers during low and moderate complexity traffic. Advanced: Consider how the evolution of a situation may always have an impact on safety and anticipate safety buffers accordingly when needed.	Content support: Prevention of incidents, safety improvement.
Aircrafts differences	Take into account difference in aircraft performance, categories and characteristics.	The trainee is fully familiar with the many differences in aircrafts characteristics and performance and anticipates well future traffic situations.	-AIRCRAFT CATEGORIES -Wake turbulence -Application of ICAO approach categories -FACTORS AFFECTING AIRCRAFT PERFORMANCE -Climb factors -Cruise factors -Descent and initial approach factors -Final approach and landing factors -Economic factors -AIRCRAFT DATA -Performance data	Beginner: Explain the wake turbulence effect and associated hazards to the succeeding aircraft. Appreciate the techniques used to prevent hazards associated with wake turbulence on succeeding aircraft. Intermediate: Integrate the influence of factors affecting aircraft during climb; Appreciate the influence of factors affecting aircraft on take-off. Advanced: Integrate information from aircraft instruments provided by the pilot in the provision of ATS; Integrate consideration of economic factors affecting aircraft	Learners shall assess and integrate aircraft performance in the provision of ATS Content support: Aircraft performance, aircraft categories, aircraft approach capabilities, Speed, mass, air density, cabin pressurization, wind and temperature...
Flexibility of trying different solutions	Flexibility of trying different options while learning individual techniques such as: radar identification, mode C verification; traffic information, vectoring techniques... Manage traffic in accordance with procedural changes.	Integrating the individual techniques into structured work in the simulator.	-Evaluate possible outcomes of different control actions. -Select an appropriate plan in time to achieve safe and effective flow of aerodrome traffic. -Balance the workload against personal capacity.	Beginner: At this level the trainee finds it difficult to adjust plans when necessary. Instead, he sticks to solutions learned during the Pre OJT-Phase and doesn't show flexibility when the situation requires adjustment. Advanced: At this level the trainee is able to adjust his plan during all traffic complexities when required.	

Working in different roles	The student is introduced to working in different role of Tower controller, ground controller, clearance delivery.	The focus is on distribution of routine tasks between the different controllers and the coordination, delegation, combination of role depending on traffic load and situation.	Organize pertinent data on data displays. Analyse pertinent data on data displays.	Beginner: Explain the responsibility for the provision of an aerodrome control service. Describe the division of responsibility. Appreciate the influence of operational requirements.	Content support: Information displayed, strip marking procedures, electronic information data displays, actions based on traffic display information.
Management of non-routine situations	Detect and respond to emergency and unusual situations related to aircraft operations and manage degraded modes of ATS operation.	Manage emergency and unusual situations related to aircraft operations. Manage degraded modes of ATS operations.	-Recognizes, from the information available, the possibility of an emergency or unusual situation developing. -Determines the nature of the emergency. -Prioritizes actions based on the urgency of the situation. -Decides upon the most appropriate type of assistance that can be given. -Follows prescribed procedures for communication and coordination of urgent situations. -Provides assistance and takes action, when necessary, to ensure safety of aircraft in area of responsibility. -Detects that ATS systems and/or equipment have degraded. -Assesses the impact of a degraded mode of operation. -Follows prescribed procedures for managing, coordinating and communicating a degraded mode of operation. -Creates solutions when no procedure exists for responding to non-routine situations.	Beginner: Respond to distress and urgency messages and signals. Know ICAO Annex 10, ICAO Doc 4444: Guidelines for controller training in the handling of unusual/emergencysituations. Advanced: Manage the general functions of aerodrome control. Manage the suspension of VFR operations.	During some exercises severe CAT and thunderstorms are present causing aircraft to request alternative FLs and diversions around weather.Some exercises contain emergencies or degradations in the ATM equipment. Four of the summative exercises shall contain one of the following: severe weather, failure of flight data processing system, emergency situation. Each exercise shall contain one of the following: diversion, Mode C error, radio communication failure, non- adherence to flight level, inability to comply with an ATC instruction. The trainee is competent to provide an integrated performance of all performance criteria in non-complex, normal and busy levels of traffic, using non-complex, simulated area surveillance airspace.

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situational awareness	Absorbs information to form an overall picture. consistently able to form an overall traffic picture based on all information available. He is able to selectively pick the right information needed for the overall picture. Keeps a clear overview of the situation by scanning regularly	- To know about perceptions' mechanisms. - To know how to anticipate situations. - To know which information needs to be scanned. - To be aware of factors that may reduce s.a. - To know how to monitor ATC system and equipment' status. - Knowledge on meteorology and its impact on her/his area of responsibility. - To be aware of her/his area of responsibility. - To know how to acquire information concerning flight data, meteorological data, electronic data, surveillance and other means available. To know how to integrate several sources of information.	-Monitor the operational situation Scan for specific or new information. -Comprehend the operational situation Anticipate the future situation. -Recognize indications of reduced situational awareness. - Be able to scan the traffic and incorporate the background traffic during all traffic. -Consistently has a complete overview of the traffic situation. -Appreciate the effect and danger of hazardous meteorological phenomena. Appreciate the effect and impact of wind. Appreciate the impact of atmospheric obscurity... -Decode information from meteorological data displays. -Integrate data about meteorological phenomena into provision of ATS.	Beginner: The trainee has still problems to form an overall picture from the magnitude of information available in the operational environment. Routinely scans surveillance data during low to medium traffic and can be observed de-collapsing menus and radar labels to obtain addition information. May fail to scan the complete screen during high traffic and only concentrate on specific area Intermediate: Routinely scans the surveillance data during all traffic levels. Can be observed accessing data from flights in other sectors and highlighting traffic that may cause a conflict in own sector. Advanced: Routinely scans the surveillance data during all traffic levels and efficiently obtains additional information through menus and radar labels, as required.	A combination of: - Theoretical training to acquire know how - Simulation to apply knowledge and to train the skill - Recurrent training on the job assessment to check the skill's behavioural markers application. Simulation to check the skill's behavioural markers
Self-management and continuous development	Demonstrate personal attribute s that improve performance and maintain as active involvement in self-learning and self-development.	- To know where to find info and support for improving his/her learning and development. - To know how to recognize if a learning need occurs. - To know how to facilitate his/her personal learning process. - To know how to ask for objective feedback. - To know techniques for assessing his/her learning. - To know how to accept and elaborate a feedback. To know what a realistic goal is, an action plan and how to create it.	Self-evaluate to improve performance Use feedback to improve performance Adapt to the demands of a situation as needed engage in continuous development activities	Advanced: -Takes responsibility for own performance, detecting and resolving own errors; Improves performance through self- evaluation of the effectiveness of actions. -Seeks and accepts feedback to improve performance; Maintains self-control and performs adequately in adverse situations. -Changes behaviour and responds as needed to deal with the demands of the changing situation. -Maintains, through personal initiative, awareness of developments and changes in Aviation. -Participates in learning activities (e.g. team meetings, briefings and training sessions. -Manages tasks effectively in response to current and future workload. -Manages interruptions and distractions effectively. -Determines if and when support is necessary based on workload. -Asks for help, when necessary. -Delegates tasks when necessary to reduce workload. -Accepts assistance, when necessary.	A combination of: Theoretical training to acquire know how on: - learning skills - asking/receiving feedback - How to define a goal and an action plan - New know how Periodical feedback session from mentor/manager/supervisor
Workload management	Adapt workload to the traffic complexity. Manage personal efficiency and work tempo Remain concentrated with various traffic levels Skill to be consistently concentrated and alert throughout the whole duty period.	- Strategies on traffic workload management. - Knowledge of what need attention. - Knowledge of the alert.	On a consistent basis and during all traffic complexities being able to: - manage workload - good strategies to handle the traffic have been developed - to ask for support from team members and able to assist them when required. - Maturity balancing own workload with service delivery - show responsibility and maturity for her/his work and team members	Beginner: As the trainee is getting used of the live environment s/he may have difficulty adapting to different workloads. It is still difficult.	A combination of: - Theoretical training to acquire know how - Simulation to apply knowledge and to train the skill - Recurrent training on the job assessment to check the skill's behavioural markers application. simulation to check the skill's behavioural markers.

Teamwork	Operate as a team member building relationship based on trust and cooperation in order to make the team strong and performative.	-To know about team dynamics. -To know how to foster collaboration. -To know how to provide feedback in a respectful and assertive way. -To know about team disfunctions. -To have a clear idea of the roles in the organization.	-Foster an atmosphere of open communication. -Encourage team participation and cooperation. -Use feedback to improve overall team performance. -Provides both positive and negative feedback constructively. -Accepts both positive and negative feedback objectively. -Shows respect and tolerance for other people. -Carries out actions and duties in a manner that fosters a team environment.	Beginner: State the relevance of TRM. Identify reasons for conflict. Describe actions to prevent human conflicts. Describe strategies to cope with human conflicts Advanced: Assist the pilot. Collect appropriate information relevant for the situation. Identify the information that has to be passed between Air Traffic Services (ATS) and the airport authority.	A combination of: - Theoretical training to acquire know how on team dynamics - How to work in international teams - How to work in team - Roles and responsibility connected to the role and the other team members, stakeholder, possible counterparts - Teambuilding activities - Recurrent team's retrospectives/ debriefing focused on team Periodical feedback session from mentor/manager/supervisor
Communication	Makes all communications in a clear and concise way Uses standard phraseology or non-standard phraseology where needed Monitors the frequency and responds to pilots' calls or requests in time Obtains and verifies acknowledgements and read backs when required.	-To know about communication process. -To know the difference. -To be aware of communication pitfalls. -To know the impact of interferences on communications. -To know the radiotelephony phraseology. -To know how a clear and concise message looks like. -To know about the existence of communicational styles. -To know how to change style according to the situation. -To know the technique of active listening.	-Select appropriate mode of communication. -Demonstrate effective verbal communication. -Demonstrate effective communication in written, automated and other non-verbal communication. -Demonstrate the ability to modify his/her style according to the receiver. -Writes or inputs messages according to protocol or in a clear and concise manner where protocol does not exist. -Communicates relevant concerns and intentions.	Beginner: Trainee still has problem to use and understand nonstandard phraseology and frequently used expressions therefore fis instructions are hesitant taken too much time and may not always be understood. Trainee gets used to the live environment and to different voices and accents. s/He finds it hard to manage his workload and priorities and monitor the sector frequency because he may be concentrating on other items. Consequently, pilot calls are missed or not reacted upon in a timely manner. He gets easily distracted by his surroundings. Trainee may miss wrong readbacks or react too slowly, due tempo, stress and attention management problems. Intermediate: Speaks clearly during moderate traffic levels but may speak too quickly if under stress. Is able to communicate accurate information without any unnecessary additional information. During high traffic levels may ocassionally have difficulties expressing him/herself clearly. Advanced: peaks clearly, accurately and concisely during all traffic situations. Ensure effective communication in all circumstances including the case where standard phraseology is not applicable.	A combination of: Theoretical and experiential training to acquire know how on: the communication process works and the possible pitfalls How to ensure effective communication at work Phraseology and standard protocol Active listening and assertive communication Communication styles Recurrent team's retrospectives/ debriefing focused on the communication in the team Periodical feedback session from mentor/manager/supervisor On the job training on phraseology and standard protocols Simulations
Problem solving and decision making	Find and implement solutions for identified hazards and associated risks, Makes well timed decisions Sets priorities correctly Takes initiative and acts accordingly.	Knowledge of the existing rules and the existing procedures. Knowledge of the possible solutions to apply in specific situations. To know the concept of priority and urgency. To know what the priorities in specific situations are. To know the impact on safety that some actions may have. To know problem-solving techniques.	-Determine possible solutions to an identified problem Prioritize effectively. -Manage risks effectively Implements an appropriate solution to a problem. -Evaluate possible outcomes of different control actions. -Determines the situations that have the highest priority. -Execute plan in a timely manner. -Perseveres in working through problems without impacting safety.	Beginner: Makes predominate use of vectoring to achieve separation. Will ocassionally use speed control when prompted but applies the technique with difficulty, often leaving the instruction to late or not applied correctly. Intermediate: Uses vectoring and ROC/ROD techniques effectively. Applies speed control correctly but may need to be prompted to act early to use speed control. Advanced: Uses vectroring, ROC/ROD and speed control effectively.	A combination of: -Theoretical and experiential training to acquire know how on: Existing rules and procedures; Possible solutions to apply in specific situations; Potential hazards; How to set priorities in specific situations; Element to assess in order to define the situation not safe; Problem solving skill; Recurrent team's retrospectives/ debriefing focused on the application of problem solving in specific situation. -Periodical feedback session from mentor/manager/supervisor. -On the job training to evaluate the good application of solutions, critical situation management and priority setting. -Simulations.
Coordination	Manage coordination between personnel in operational positions and with other affected stakeholders.	-Determine the need for coordination. -Select appropriate method of coordination. -Perform coordination.	-Coordinates with personnel in other operational positions and other stakeholders, in a timely manner. -Selects coordination method based on circumstances, including urgency of coordination, status of facilities and prescribed procedures. -Coordinates the movement, control and transfer of control for flights using the prescribed coordination procedures. -Coordinates changes of status of operational facilities such as equipment, systems and functions Coordinates changes of status of airspace and aerodrome resources -Uses clear and concise terminology for verbal coordination. -Uses standard ATS message formats and protocol for non-verbal coordination. -Uses clear and concise non-standard coordination methods when required Conducts effective briefings during position handover.	advanced: Identify the need for coordination. Use the available tools for coordination. Initiate appropriate coordination. Analyse effect of coordination requested by an adjacent position/unit. Select, after negotiation, an appropriate course of action. Ensure the agreed course of action is carried out.	A combination of: - Theoretical training to acquire know how. - Simulation to apply knowledge and to train the skill. - Recurrent training on the job assessment to check the skill's behavioural markers application. Simulation to check the skill's behavioural markers.

Figure 5: Study Pathway for a New Entrant skilling to become a rTower.

2.4.1.2 Professional Tower ATCO: Reskilling

The Mary ATC Persona was developed to represent the profile of a professional tower ATCO, who has to be reskilled into a remote tower ATCO and is supposed to be relocated to another city in order to start working as a remote tower controller in a multiple remote tower. In contrast to Bill, Mary was designed as a person who feels at ease with technical systems but still needs some assistance when solving complex operational issues. In fact, although she may be very careful in doing her job (she tends to follow procedures and rules and considers safety as being very important), Mary was imagined as having had hard times in completing her initial training.

On the other hand, Mary was designed as a person who is willing to relocate, because of the positive impact on her social life: in fact, she was imagined as being single and thus open to spending more time with friends. She never really integrated with her own village and would thus be keen on moving to a big city for her social life and entertainment. To sum up, Mary is very motivated to relocate and work in a highly digitalized environment but may not be entirely at ease or totally independent in solving complex situations. In line with this, Mary's training needs are expected to deal with advanced use of the remote tower systems, as for the technical skills, and with problem-solving, decision making and service orientation among the transversal skills, so as to enhance the possibility that she successfully concludes her remote tower training. This issue is very important to be considered: in fact, given that all professional tower controllers will attend a reskilling training program to become remote tower controllers, what if the training is not successful? The Mary ATC Persona was designed to highlight this issue, so as to address specific training needs and to design targeted training programs.

PROFESSIONAL TOWER ATCO: Reskilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Much of the basic knowledge and skills required to operate as an ATCO at a particular unit could be assumed to have already been acquired for an individual who is already a licence holder at that unit. The training would focus on the specific procedures and knowledge associated with the new position. The assessment would also focus on these new areas, as the existing knowledge and skills will have already been tested and will likely be subject to on-going competence review.	i. Introduction to remote aerodrome air traffic services ii. Concept of remote aerodrome air traffic services iii. 'Remote tower modules' iv. 'Remote tower centre' v. Technical enablers used for remote aerodrome air traffic services vi. Operational applications vii. Operating environment viii. Configuration of the RTM and RTC (if applicable) and modes of operation ix. Visual presentation x. layout and orientation; xi. technical capabilities and limitations of a 'visual surveillance system' including: 1. impact of weather conditions on site the aerodrome; 2. end-to-end delay; 3. frame rate, 4. any differences in light conditions between the aerodrome and the visual presentation; 5. 'dead' pixels; 6. any overlaid information and any site-specific equipment/functions such as sun filters; and 7. seasonal settings. 8. Set-up and characteristics of the local equipment at the aerodrome, e.g. location of cameras, signalling lamp, etc. 9. Familiarisation with the physical aerodrome(s) environment and the different local stakeholders via liaison visit(s) 10. Local weather characteristics 11. Human factors aspects 12. Human factors influence on remote aerodrome air traffic services xii. Rostering arrangements e.g. Additional unit endorsements at a remote tower centre. 1. Factors that can generate fatigue in a 'remote tower' environment for example: 2. eye strain caused by the performance of the visual presentation or by contrast in lighting against the background; 3. artificial light and/or lack of daylight in the RTM) 4. Preventing and mitigating strategies on fatigue. 5. Procedures for degraded modes, for example: 6. Complete or partial loss of the visual presentation, Note, such loss may not be apparent to other stakeholder e.g. operations staff, pilots and additional mitigations required. 7. Corrupt, delayed or frozen image 8. Loss or degradation of the 'binocular functionality' a. Multiple Mode of Operation i. When performing 'multiple mode of operation', the following items should also be considered:
		1. Use of communication facilities (e.g. aeronautical mobile service, aeronautical fixed service and surface movement control service) for simultaneous provision of air traffic services in geographically separated areas of responsibility 2. Applicable procedures for traffic management, such as traffic prioritisation, enabling multiple mode of operation 3. Procedures for prioritising between aerodromes 4. Procedures for the transferring/merging/splitting of aerodromes in an RTM1 5. Different weather and light conditions at different aerodromes 6. Human capabilities/limitations with regard to the simultaneous handling of more than one aerodrome and distribution of attention
	Virtual technology	Advanced use of a panoramic display & transition of ambient sound Advanced use of pan tilt and zoom cameras Advanced automatic identification and tracking of aircraft Advanced use of Head-up display of information Advanced facility to highlight certain objects / information (augment reality) Advanced use of video recording and play back Advanced use of electronic flight strips Advanced use of visual Enhancement Technology

	Met	MET Observer Training Requirements a. Annex V to the ATM/ATS IR2 requires that service provider's staff providing the MET observing service shall have and maintain adequate technical and operational expertise. b. Official Meteorological Reports (produced by Meteorological Service Providers certificated under Annex V to the ATM/ATS IR40 as an ANSP which, if in the form of a meteorological aerodrome report (METAR), may be disseminated beyond an aerodrome to pilots and other meteorological service providers using processes that adhere to ICAO Standards. An observer shall be accredited and competent to produce these observations c. Local Routine and Local Special Reports (produced by Meteorological Service Providers certificated under Annex V1 to the ATM/ATS IR 40 as an ANSP) that are not disseminated beyond the aerodrome. MET observers must have a Basic Meteorological Observing competency d. Details on MET observer training and competency requirements are published in CAP 7463 e. Should an aerodrome wish to provide a Remote Aerodrome Meteorological Observing Service the permission of the CAA is required and the CAA will require assurance that the service provider has carried out a review of Unit Met training and competency assessments for ATS personnel and/or accredited observers (and other personnel if applicable) to ensure that training syllabi and competency checks are updated where necessary to reflect any differences in the provision of a RAMOS. MET Observer Conversion Training a. MET Observer accreditation may only be transferred to a Remote Aerodrome Meteorological Observing Service once the service provider has ensured that the observer has been provided with sufficient training to ensure that the observer can competently use the remote observing equipment. b. Training and competency assessments of Remote Aerodrome Meteorological Observers (RAMO) should, as a minimum, take account of the following: i. Knowing and using the features and settings of the cameras and other remote observing equipment to best advantage. ii. Understanding and accounting for the differences between the camera images and the image that is seen by the human eye. iii. Understanding and accounting for the limitations of the camera and other remote observing equipment. iv. Understanding the advantages and disadvantages of the location (height and view) of the camera and other remote observing equipment. v. Remote observing contingency arrangements. c. Appropriate competency assessments must be carried out to ensure that MET observers are familiar with remote observing equipment, processes and procedures before commencing unsupervised operational remote observing duties. Multiple Mode of Remote Met Observing Operation a. The CAA will require additional assurances in support of requests to operate a Multiple Mode of MET observing operation. Where applicable this should include addressing factors as described in F 1.4.a, and if, or as, necessary specific factors relating to MET service provision including consideration of: i. Understanding how routine observations from multiple sites will be made and disseminated in a timely manner, and ii. How a continuous weather watch will be maintained for multiple sites. MET Observer Ongoing Competency Assessments a. Every accredited observer should be assessed on an annual basis by the Manager, or other nominated representative, of the Aerodrome Met Observing Service Provider to ensure the observer's ongoing competence. b. The Unit's competency scheme must be reviewed and updated as applicable to reflect the competencies required to perform remote observing duties where appropriate including, as a minimum, the items listed in F.6.2.b.
	Unit endorsement course	TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL SERVICE FROM A REMOTE TOWER For air traffic controllers providing aerodrome control service from a remote tower, the following subjects, subject objectives, topics and subtopics should be integrated into the unit endorsement course: Subject 1: REMOTE TOWER OPERATION The subject objective is: Learners shall acquire knowledge of the concept of remote tower operations, the characteristics of the operating environment, as well as the functions and limitations of the equipment. 1.1 —Operational applications 1.2 —Remote Tower Modules (RTMs), Remote Tower Centre (RTC) 1.3 Advanced Visual Features (AVFs) —Technologies, if available, to enhance visual presentation TOPIC 2 OPERATING ENVIRONMENT 2.1 —Configuration of the RTM 2.2 —Visual presentation at the RTM, e.g. layout of the visual presentation, end-to-end delay, orientation, differences in light conditions between the aerodrome and the Out-The-Window (OTW) visual presentation, use of filters, recognition of 'dead' pixels 2.3 —Operating methods 2.4 —Set-up and characteristics of the local equipment, including the location of the cameras 2.5 —Familiarization with the physical aerodrome environment and the different stakeholders via study visit(s) 2.6—Weather conditions' impact on the equipment and on the visual presentation Subject 2: HUMAN FACTORS: The subject objective is: Learners shall appreciate the necessity to consider the specific human factors influence on the remote provision of aerodrome control service. Subject 3: ABNORMAL SITUATIONS The subject objective is: Learners shall recognize specific abnormal situations and manage their impact. TOPIC 1 LOSS OF VISUAL PRESENTATIONS 1.1 —Complete loss of visual presentation, e.g. 'blank screens' or frozen presentation 1.2 —Visual presentation not being current TOPIC 2 DEGRADED MODES OF VISUAL PRESENTATION 2.1 —Partial loss of visual presentation (e.g. loss of a screen(s) or camera failure) 2.2 —Loss or degradation of the labelling system, if available 2.3 —Loss or degradation of the zooming functionality and signaling lamp

	Main Topic	Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	SA	Update training on SA to exclude the use of audio sound
	Visiting Aerodromes	Ensure ATCO/AFISOs are able to visit the aerodromes they are controlling to ensure their local knowledge and awareness are somewhat maintained
	Virtual Tools	NTS; new training on virtual meeting tools for TRM meeting with local staff when needed (aerodrome staff...) as it was done face to face in the past and with remote tower it needs to be done online most of the time.
	New virtual environment	Fill the gap betweem mental models from years of experience and the new skills to acquire

COMPETENCES (select 3 to 5 to each group)					
Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situational awareness	Comprehend the current operational situation and anticipate future events. This competency takes into account the transition to the new remote scenario	- To know about perceptions' mechanisms - Knowledge of what have changed form a physical tower to a remote one. - To know which information needs to be scanned in a virtual scenario. - To be aware of factors that may reduce s.a. - To know how to monitor ATC system and equipment' status in a virtual scenario. - To know how to acquire information concerning flight data, meteorological data, electronic data, surveillance and other means available in a remote and virtual setting.	Monitor the operational situation Scan for specific or new information. Comprehend the operational situation Anticipate the future situation. Recognize indications of reduced situational awareness.	Advanced: consistently able to form an overall traffic picture based on all information available. He is able to selectively pick the right information needed for the overall picture. able to scan the traffic and incorporate the background traffic during all traffic complexities. The trainee consistently has a complete overview of the traffic situation. able to anticipate the future traffic situation safely and correctly in a consistent way for the full flight profile through his sector.	A combination of: - Theoretical training to acquire know how on the virtual stimuli to take in to account Simulation to apply knowledge and to train the skill Recurrent training on the job assessment to check the skill's behavioural markers application. Simulation to check the skill's behavioural markers.

Change Adaptability	Adaptability means one is able to quickly respond to changing trends, innovation, destabilization, industry shifts, and so forth.	- Knowledge of the change process and possible resistances to it - Knowledge of techniques to apply when change is needed - To know the personal leverages to change	Looks for ways to make changes work rather than only identifying why change will not work. Adapts to change quickly and easily. Makes suggestions for increasing the effectiveness of changes. Shows willingness to learn new methods, procedures, or techniques Shifts strategy or approach in response to the demands of a situation.	Beginner: Embrace Learning. Change Your Thought Process. being open to the thoughts and opinions of others, i.e. different perspectives. Advanced: Ability to share best change management practices. Ability to correspond, influence and communicate the value that effective change management can confer on an organisation's competitive advantage.	A combination of: Theoretical training to acquire know how on - change management - resistances to change - coping strategies Coaching
Self-management and continuous development	Demonstrate personal attributes that improve performance and maintain as active involvement in self-learning and self-development. Apply continuous learning in formal and informal way through training, sharing, asking and receiving feedback.	- To know where to find info and support for improving his/her learning and development - To know how to recognize if a learning need occurs - To know how to facilitate his/her personal learning process - To know how to ask for objective feedback - To know techniques for assessing his/her learning - To know how to accept and elaborate a feedback - To know what is a realistic goal, an action plan and how to create it	-Manage stress in an appropriate manner. -Self-evaluate to improve performance. -Use feedback to improve performance. -Adapt to the demands of a situation, as needed. -Engage in continuous development activities. -Self-evaluate to improve performance. -Use feedback to improve performance. -Adapt to the demands of a situation as needed engage in continuous development activities.	Advanced: Takes responsibility for own performance and self-corrects own errors Improves performance through self-evaluation of the effectiveness of actions Accepts feedback and learns from mistakes Maintains self-control in all situation and performs adequately in adverse situations Prioritises, changes behaviour and responds as needed to deal with the demands of the changing situation Maintains, through personal initiative, good knowledge of aviation evolution Participates in planned learning activities (e.g. team meetings, briefing and training sessions)	Assessment of new know how status Action plans with implementation of new knowledge Coaching/mentoring
Digital competences	Digital competence is a combination of knowledge, skills and attitudes with regards to the use of technology to perform tasks, solve problems, communicate, manage information. **https://digital-competence.eu/dc/front/what-is-digital-competence/**	- Awareness on digital competencies and their meaning - To know how to use digital and virtual instruments to positively accomplish tasks - To know the potentialities that digital tools have on the individual performance	-To analyse, interpret and critically evaluate the data, information and digital content. -To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. -To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.	Beginner: At this level the trainee still falls behind in monitoring and updating the electronic displays due to the new live environment and attention management problems. Advanced: At this level the trainee consistently monitors his displays and keeps them updated by appropriate system inputs.	A combination of: Theoretical training to acquire know how on - virtual communication - digital mindset - efficiency and digital tools Simulation to apply knowledge and to train the skill
PROBLEM SOLVING AND DECISION MAKING https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework	Find and implement solutions for identified hazards and associated risks in a new remote environment	Knowledge of the rules and the procedures changed due to the virtual environment Knowledge of the possible solutions to apply in specific situations due to the virtual environment To know how solve problems in a virtual environment and using digital tools	Determine possible solutions to an identified problem Prioritize effectively. Manage risks effectively. To identify technical problems when operating devices and using digital environments, and to solve them (from troubleshooting to solving more complex problems).	Advanced: trainee shows independence and resolve in timely decision making, during all traffic complexities. The trainee sets priorities correctly all the time. He takes the initiative during all traffic complexities.	Assessment of new know how status Action plans with implementation of new knowledge Simulation to apply knowledge and to train the skill

Figure 6: Study Pathway for the reskilling of a Professional Tower ATCO.

2.4.1.3 On the job rTower Trainer: Upskilling

The Bill ATC Persona was developed to represent the profile of a senior professional tower ATCO and OJTI, who has to be upskilled into a remote tower ATCO and OJTI and is supposed to be relocated to another city in order to start working as a remote tower controller and OJTI in a multiple remote tower. Bill was designed as a person who feels in control of the local systems and is very proactive and precise. He was imagined as a person who likes, during his spare time, to set- up operational simulation scenarios and manage future procedures for the airport. Bill represents a top expert and proficient controller. On the other hand, he was imagined not to be at his best with new technology and pretty conservative, thus not that motivated in working in a highly digitalized environment. Moreover, Bill was designed as a person who is not that happy to be relocated to another city, because of the impact on his social life and work-life balance, including care of his children. These features were highlighted in compliance with the results of the survey and interviews as well as the expert advice collected during the focus group, where the issues of the controllers' relocation and of the OJTI's knowledge and attitudes towards new teaching methods and approaches (i.e., distant learning) were highlighted as issues playing a relevant role. In line with this, Bill's training needs are expected to deal with advanced use of the remote tower systems, as for the technical skills, and with creative thinking, digital literacy, and lifelong learning among the transversal skills, so as to support motivation towards relocation and acceptance of advanced technologies.

The purpose of conversion training is the acquisition and maintenance of the competencies required to perform as an air traffic controller. It includes situations where already licensed/rated controllers undertake further training as a result of a move to a different working position or new location, whilst retaining the same rating; to acquire an additional rating and as a result of upgrades to systems and/or changes to procedures. Conversion training is designed to provide knowledge, skills, and attitudes appropriate to a change in the operational environment. Since each conversion will be unique, each conversion training syllabus will be tailor-made for each change in the operational environment.

ON THE JOB RTOWER TRAINER: Upskilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Introduction to remote aerodrome air traffic services	- Operating environment - Human factors aspects - Procedures for degraded modes - Concept of remote aerodrome air traffic services - Remote tower modules - Technical enablers used for remote aerodrome air traffic services - Operational applications Sources: EASA 'Guidance Material on remote aerodrome air traffic services' — Issue 2 Easy Access Rules for Air Traffic Controllers' Licensing and Certification (Regulation (EU) 2015/340)
	Virtual technology	- Advanced use of a panoramic display & transition of ambient sound - Advanced use of pan tilt and zoom cameras - Advanced automatic identification and tracking of aircraft - Advanced use of Head-up display of information - Advanced facility to highlight certain objects / information (augment reality) - Advanced use of video recording and play back - Advanced use of electronic flight strips - Advanced use of visual Enhancement Technology
	Main Topic	**Description of content**
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying…	SA	Update training on SA to exclude the use of audio sound Monitors the meteorological conditions that impact on own area of responsibility. Analyses the actual situation based on information obtained from data displays instead of direct monitoring.
	Visiting Aerodromes	Ensure ATCO/AFISOs are able to visit the aerodromes they are controlling to ensure their local knowledge and awareness are somewhat maintained
	Virtual Tools	NTS; new training on virtual meeting tools for TRM meeting with local staff when needed (aerodrome staff…) as it was done face to face in the past and with remote tower it needs to be done online most of the time.

COMPETENCES (select 3 to 5 to each group)					
Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of…***	***With this skill someone should be capable of….***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Change Adaptability	Adaptability means one is able to quickly respond to changing trends, innovation, destabilization, industry shifts, and so forth. Quickly and efficiently respond to changes in the surrounding and be flexible in adaptation to new contexts and virtual scenario.	- Knowledge of the change process and possible resistances to it. - Knowledge of techniques to apply when change is needed. - To know the personal leverages to change.	Looks for ways to make changes work rather than only identifying why change will not work. Adapts to change quickly and easily. Makes suggestions for increasing the effectiveness of changes. Shows willingness to learn new methods, procedures, or techniques. Shifts strategy or approach in response to the demands of a situation.	Intermediate	A combination of: Theoretical training to acquire know how on - change management. - resistances to change. - coping strategies. Coaching.
Self-management and continuous development	Demonstrate personal attributes that improve performance and maintain as active involvement in self-learning and self-development. Apply continuous learning in formal and informal way through training, sharing, asking and receiving feedback.	- To know where to find info and support for improving his/her learning and development. - To know how to recognize if a learning need occurs. - To know how to facilitate his/her personal learning process. - To know how to ask for objective feedback. - To know techniques for assessing his/her learning. - To know how to accept and elaborate a feedback. - To know what a realistic goal is, an action plan and how to create it.	Self-evaluate to improve performance. Use feedback to improve performance. Adapt to the demands of a situation as needed engage in continuous development activities.	Advanced	Assessment of new know how status. Action plans with implementation of new knowledge. Coaching/mentoring.
Stress management	Recognise and manage stressful situations with appropriate and effective coping strategies.	- Awareness on stress mechanism. - Awareness on his/her personal stressors. - Knowledge of short term and long-term coping strategy. - Knowledge of the impact of stress on the performance. - Knowledge of personal characteristics that are positively and negatively impacting on his/her stress management. - Knowledge of personal stress symptoms	Recognise symptoms of stress and their impact on the performance. Discuss ability for good decision making and problem solving under pressure. Discuss and analyse system/automation disturbance cases and effect on individual and team stress.	Intermediate	A combination of: Theoretical training to acquire know how on - Stress mechanisms. - Coping strategies. - Individual characteristics that may affect. stress management. Mentoring. Coaching. Psychological support (if needed).

Figure 7: Study Pathway for the upskilling of on the job rTower Trainer.

2.4.2 Commercial Aviation Study Pathways

Considering the four personas developed for the Commercial Aviation sector (CA), four study pathways were developed:

- New Entrant Single Pilot: Skilling
- New Entrant Ground Pilot: Skilling
- Professional Commercial Pilot: Reskilling to single pilot onboard
- Professional Commercial Pilot: Reskilling to ground pilot

Each study pathway was designed considering the personas context and pre-existence knowledge and skills, which are the starting point assumption from building the study pathway focusing on the skilling, reskilling, and upskilling for the future scenarios.

Finally, in order to let explore in more detail the study pathway, the reader can find a link in each Study Pathway Figure Legend that leads to the study pathway independent document.

2.4.2.1 New Entrant Single Pilot: Skilling

The study pathway of the new entrant single pilot assumes that he/she has already the theoretical knowledge and practical skills of any licensed commercial pilot (ATPL/A). He/she is already able to fly small aircraft that transport few passengers. The study pathway will describe which additional knowledge and skills he/she needs to become a single pilot on a more powerful aircraft that transport many passengers.

NEW ENTRANT SINGLE PILOT: Skilling		
FORMAL TRAINING		
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	**Main Topic**	**Description of content**
	Theoretical knowledge about the new automated systems specific of SPO.	- Description of the functioning. - Logic. - Rules. - Failure modes. - Context of utilization.
	Theoretical knowledge about the systems of the new type of aircraft.	- Description of the functioning. - Logic. - Rules. - Failure modes. - Context of utilization.
	Theoretical knowledge about the procedures related to the new type of aircraft.	- Description of the procedures. - Context of use. - Prioritizing rules. - Philosophy of use.
	Theoretical knowledge of specific human factors issues related to automation pitfalls.	- Mode errors: when the pilot is not aware of the mode in which the automated system is functioning. - Complacency and over-reliance: tendency to trust excessively automation. - "Out of the loop" phenomenon: with reduction of situation awareness. - "Clumsy" automation: when automation adds complexity to a task.
	Theoretical knowledge about cabin crew and passenger management.	- Cabin crew management. - Passenger management. - Company policies on abnormal procedures.
	Theoretical knowledge of procedures of communication with the ground pilot.	- Phraseology associated to communications between onboard pilot and ground pilot. - Allocation of roles and responsibilities between onboard pilot and ground pilot.
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	**Main Topic**	**Description of content**
	Simulation training on the specific type of aircraft simulator.	- Checklists for simulated flight and operations. - Flight training preparation. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Briefing and debriefing with ground pilot or instructor. - Emergency simulation. - Hand-eye coordination. - Simulations of high workload situations.
	Real flight training on the specific type of aircraft with supervisor on-board.	- Operational procedures. - Application of theoretical knowledge. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Briefing and debriefing with ground pilot or instructor. - Hand-eye coordination. - Pre-flight preparation and inspection. - Flight in abnormal conditions. - Landing missed approach. - Ends with the "release" of the single pilot.
	Real flight training on the specific type of aircraft with supervisor on ground.	- Application of theoretical knowledge. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Operational procedures. - Briefing and debriefing with ground pilot or instructor. - Hand-eye coordination. - Pre-flight preparation and inspection. - Flight in abnormal conditions. - Landing missed approach.

COMPETENCES (Select 3 to 5 to each group)					
Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Aircraft Flight Path Management, manual control	Controls the aircraft flight path through manual flight, including appropriate use of flight management system(s) and flight guidance systems.	-Systems functioning laws (including flight control laws: normal, abnormal, direct...) -Breakdown modes and consequences. -Interactions between systems.	-Controls the aircraft manually with accuracy and smoothness as appropriate to the situation. -Detects deviations from the desired aircraft trajectory and takes appropriate action. -Contains the aircraft within the normal flight envelope. -Controls the aircraft safely using only the relationship between aircraft attitude, speed and thrust. -Manages the flight path to achieve optimum operational performance. -Maintains the desired flight path during manual flight whilst managing other tasks and distractions. -Selects appropriate level and mode of flight guidance systems in a timely manner considering phase of flight and workload. -Effectively monitors flight guidance systems including engagement and automatic mode transitions.	Intermediate or advanced	Simulator and real flights with a focus on following training topics: - Flight path monitoring. - Human performance and limitations.
Application of procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge.	-Pre-requisites to procedures. -Level of priority of procedures. -The logic/philosophy behind each procedure. -Possibility to delegate the procedure to the ground pilot or to the system.	-Identifies the source of operating instructions. -Follows SOPs unless a higher degree of safety dictates an appropriate deviation. - Identifies and follows all operating instructions in a timely manner. -Correctly operates aircraft systems and associated equipment. -Complies with applicable regulations. -Applies relevant procedural knowledge. -Always checks his/her actions (close-loop procedure).	Intermediate or advanced	Studying, learning and practising on dedicated computer assisted training, with a focus on following training topics: - Operational procedures for ground pilots. - Air law.
Specific AI and automation knowledge related to the automated systems used in the single pilot aircraft	Knows how and when to trigger or disable automation	-The use, benefits and consequences of the automated systems and AI used in the single pilot aircraft. -The limitations of AI and automation.	-Use efficiently the automated systems and relieve his workload	Advanced	Studying and learning + simulator and real flight practice, with a focus on following training topics: - use of specific and AI automated systems. - simulation of breakdown of specific AI and automated systems.

Behavioral Skills: Considering the skills identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situation awareness	Perceives and comprehends all the relevant information available and anticipates what could happen that may affect the operation.	-Theoretical model of situation awareness. -Factors affecting situation awareness: workload, stress.	-Managing his/her activity and select adequate options (search of missing information or diverting to fall back decision).	Intermediate or advanced	Studying and learning with a focus on following training topics: - Human performance and limitations. - Flight path monitoring.
Problem Solving and Decision Making	Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes.	-Theoretical models of decision making in complex situations (e.g., naturalistic decision making). -Consequences of workload, stress, and fatigue on quality of decisions.	-Seeks accurate and adequate information from appropriate sources. -Identifies and verifies what and why things have gone wrong. -Employ(s) proper problem-solving strategies. -Perseveres in working through problems without reducing safety. -Uses appropriate and timely decision-making processes. -Sets priorities appropriately. -Identifies and considers options effectively.	Intermediate or advanced	Studying and learning with a focus on following training topic: - Human performance and limitations.
Communication skills	Demonstrates effective oral, non-verbal, and written communications, in normal and non-normal situations.	-Theoretical knowledge on communication with remote operators. -Importance of context sharing.	-Ensures the recipient is ready and able to receive the information. -Selects appropriately what, when, how and with whom to communicate. -Conveys messages clearly, accurately, and concisely. -Confirms that the recipient correctly understands important information. -Listens actively and demonstrates understanding when receiving information. -Asks relevant and effective questions. -Adheres to standard radiotelephone phraseology and procedures. -Accurately reads and interprets required company and flight documentation. -Accurately reads, interprets, constructs, and responds to datalink messages in English.	Intermediate or advanced	Role play, games, simulations and real flights with a focus on following training topics: - VFR and IFR communication. Human performance and limitations.
Workload Management	Manages available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.	- Aviation psychology (human overload and underload, fatigue and stress management, etc.) - Threat and error management - Time management / planning - Multi-tasking strategies	- Maintaining self-control in all situations. - Planning, prioritizing, and scheduling tasks effectively. - Managing time efficiently when carrying out tasks. - Offering and accepting assistance and asking for help early. - Reviewing, monitoring, and cross-checking actions conscientiously. - Verifying that tasks are completed to the expected outcome. - Managing and recovering from interruptions, distractions, variations, and failures effectively. - Performing all the above for one or more aircraft with a single on-board pilot.	Intermediate or advanced	Simulations and/or games with a focus on following training topic: - Human performance and limitations.

Figure 8: Study Pathway for a New Entrant skilling to become a Single Pilot.

2.4.2.2 New Entrant Ground Pilot: Skilling

The Study Pathway for the New Entrant Ground Pilot does not assume any prior knowledge beyond high school (i.e. aviation experience). However, it was built assuming that, in the event of pilot incapacitation, the ground pilot will be able to use the onboard automation (e.g. autopilot, FMS) to land the aircraft safely i.e. it is not expected that the ground pilot will control/fly the aircraft manually.

NEW ENTRANT GROUND PILOT: Skilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
	VFR and IFR communications	- Definitions - Read-back requirements - Level changes and reports - Distress and urgency procedures - Transmission of letters, numbers, etc. - Weather information terms - Procedures in event of loss of communications

Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Air law	- International law - Airworthiness - Aircraft registration - Licensing - Rules of the air - Procedures for air navigation services - Air traffic services and ATM - Aerodromes - Search and rescue - Aeronautical information services
	Principles of flight	- Airflow - Aerodynamic forces and moments - Wing shape - Angle of attack - Lift - Drag - Stall - Mach - Speed brakes - Flaps and slats - Compressibility - Stability and control
	Aircraft performance	- Stages of flight - Variables affecting performance - Speed definitions - Takeoff performance - Climb performance - Cruise performance - Descent performance - Cost Index - Landing performance - Performance with one engine inoperative
	Aircraft systems	- Hydraulics - Landing gear - Pneumatics - Anti-ice and de-icing systems - Fuel system - Power plants (turbine engines) - Electrics - Smoke, fire, and rain protection systems - Oxygen systems
	Flight planning	- Mass and balance - Flight plan - Fuel - Weather forecasts and reports - NOTAMs - Takeoff calculations
	Navigation	- Principles of navigation - Radio navigation - Satellite navigation - Inertial navigation
	Surveillance	- PSR - SSR - ADS-B - Weather radar - TCAS - TAWS - EGPWS
	The flight deck	- Cockpit layout and alerting - Cockpit controls (sidestick, rudder pedals, MCDU, FCU, switches, levers, buttons, etc.) - Cockpit instruments and displays (PFD, ND, EICAS, overhead panel, central pedestal, standby instruments, radios, etc.)
	Meteorology	- The atmosphere - Wind - Clouds - Precipitation - Air masses and fronts - Pressure systems - Flight hazards - Gathering and interpreting weather information (forecasts and reports)
	Human performance and limitations	- Situation awareness - Human information processing - Safety awareness - Threat and error management - Workload management - Crew Resource Management (CRM)
	Operational procedures for ground pilots	- Responsibilities of the ground pilot - Responsibility to record voice/data during a flight - Responsibilities of the ground pilot with regard to MEL - Flight preparation forms to be completed before flight - Low visibility operations; Aerodrome operating minima; ETOPS operations; Handover procedures - Abnormal and emergency procedures (pilot incapacitation, loss of link, emergency landing, etc.) - Requirements for training of ground pilot (including recurrent training) - Requirements for ground pilot to operate on more than one type/variant - Duty-time limitations and rest requirements of ground pilot - Requirements regarding minimum equipment of GCS
	Automatic flight control and management	- Autopilot - Primary and secondary flight controls - FMS - Fly-by-Wire (FBW) control systems - Autothrust - Control laws and flight envelope protection - Autoland
	Ground control station systems	- Communication system - Communication, control and telemetry links - Controls and displays - Decision support systems (including AI-enabled support systems) - Alerting - Multi-modal user interaction (touch, voice, etc.) - GCS redundancy requirements - Voice and data recording (both flight data and GCS data)
	Flight path monitoring	- Principles of effective monitoring - Aircraft performance monitoring systems monitoring - Monitoring of the single on-board pilot - Monitoring of operational factors (weather, etc.)
	Cybersecurity	- Security threats in aviation systems - Common attack methods (hacking, spoofing, jamming, etc.) - Threat detection and alerting - Countermeasures (GNSS augmentation, anti-jam antennas, encryption, anomaly detection, etc.)

	Main Topic	Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	VFR and IFR Radio Telephony (RT) training	- RT phraseology - Departure procedures (establishing communication with the on-board pilot and ATC; clearances; frequency changes; etc.) - En-route procedures (position reporting, frequency changes, etc.) - Circuit and arrival procedures (circuit calls, frequency changes, etc.) - Procedures in case of loss of communication between the ground pilot and ATC - Procedures in case of loss of communication between the ground pilot and the on-board pilot - Distress and urgency procedures (PAN PAN, MAYDAY, etc.)
	Basic ground pilot training	This part of the training will focus on 'simple' aircraft (single engine, basic instrumentation, and automation) and VFR operations (local and cross-country flying). The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot. - Operation of GCS hardware and software - Familiarization with aircraft type, systems, and instruments - Establishing communication and telemetry links with the aircraft and checking their integrity - Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) - Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications - Monitoring of the aircraft's systems (fuel, electrics, etc.) based on GCS data and pilot communications - Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools - Monitoring of the on-board pilot and cross-checking of his/her actions - Communicating with the on-board pilot and sharing information (e.g. weather updates, position reports, etc.) - Executing checklists together with the on-board pilot (e.g. startup, taxi, takeoff, landing, etc.) - Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g. engine failure, low fuel, diversion, weather avoidance, etc.) - Delegation of tasks from the on-board pilot to the ground pilot - Procedures in the event of loss of communication with the on-board pilot - Procedures in the event of loss of telemetry link - Debriefing - Procedures for handing over to another ground pilot at the end of a shift

	Advanced ground pilot training	This part of the training will focus on more advanced aircraft (multi-engine, advanced instrumentation and automation) and IFR operations (local and cross-country flying). The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot. - Operation of GCS hardware and software; - Debriefing - Familiarization with aircraft type, systems, instruments, and automation - Establishing communication, control and telemetry links with the aircraft and checking their integrity - Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) - Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications - Monitoring of the aircraft's systems (fuel, hydraulics, avionics, etc.) based on GCS data and pilot communications - Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools - Monitoring of the on-board pilot and cross-checking of his/her actions - Communicating with the on-board pilot and sharing information (e.g. weather updates, position reports, etc.) - Executing checklists together with on-board pilot at various stages of the flight (e.g. startup, taxi, takeoff, landing, etc.) - Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g. engine failure, low fuel, diversion, weather avoidance, etc.) - Delegation of tasks from the on-board pilot to the ground pilot - Procedures in the event of loss of communication with the on-board pilot; - Procedures in the event of loss of control and telemetry links - Procedures for taking over control of the aircraft (e.g. in the event of pilot incapacitation) via the GCS - Control of aircraft automation (autopilot, FMS, etc.) and other equipment (e.g. radios) via the GCS - Procedures for selecting an appropriate airport/runway and landing the aircraft remotely via the GCS (precision approach, missed approach, etc.) - Procedures for handing over to another ground pilot at the end of a shift
	Type-specific ground pilot training	This training will focus on the specific type(s) of aircraft which will be handled by the ground pilot during commercial operations. The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot. - Operation of GCS hardware and software; - Debriefing - Familiarization with aircraft type, systems, instruments, and automation (for this part of the training, the ground pilot will be exposed to the flight deck of the aircraft, particularly to the on-board automation which the ground pilot will interact with should he/she need to take over control of the aircraft. This will give the pilot an appreciation for the on-board automation and how it relates to the GCS) - Commercial considerations; Standard Operating Procedures (SOPs) - Establishing communication, control and telemetry links with the aircraft and checking their integrity - Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) - Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications - Monitoring of the aircraft's systems (fuel, hydraulics, avionics, etc.) based on GCS data and pilot communications - Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools - Monitoring of the on-board pilot and cross-checking of his/her actions - Communicating with the on-board pilot and sharing information (e.g. weather updates, position reports, etc.) - Executing checklists together with on-board pilot at various stages of the flight (e.g. startup, taxi, takeoff, landing, etc.) - Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g. engine failure, low fuel, diversion, weather avoidance, etc.) - Delegation of tasks from the on-board pilot to the ground pilot - Procedures in the event of loss of communication with the on-board pilot - Procedures in the event of loss of control and telemetry links - Procedures for taking over control of the aircraft (e.g. in the event of pilot incapacitation) via the GCS - Control of aircraft automation (autopilot, FMS, etc.) and other equipment (e.g. radios) via the GCS - Procedures for selecting an appropriate airport/runway and landing the aircraft remotely via the GCS (precision approach, missed approach, etc.)

COMPETENCES (select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Application of Procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge.	- Airline SOPs in normal scenarios - Airline SOPs in abnormal and emergency scenarios. e.g. on-board pilot incapacitation, loss of communication link, loss of control and telemetry link, etc. - Air law.	- Identifying the source of operating instructions. - Following SOPs unless a higher degree of safety dictates an appropriate deviation. - Identifying and following all operating instructions in a timely manner. - Complying with applicable regulations. - Applying relevant procedural knowledge.	Beginner	Operational procedures for ground pilots. Air law.
Aircraft Flight Path Monitoring and Pilot Monitoring	Demonstrates effective monitoring of the aircraft and of the single on-board pilot.	- Monitoring role of the ground pilot. - Operational policies, procedures, and practices for effective monitoring. - Monitoring of automated systems - Monitoring in normal and abnormal situations. - Aviation physiology and psychology (human factor limitations, etc.). - Aircraft general knowledge. - Aircraft performance. - Surveillance systems (to monitor weather, traffic and terrain).	- Monitoring the flight path of the aircraft, including the trajectory, energy state, power settings and automated systems directly affecting the flight path (e.g. autopilot, auto-thrust, FMS). - Monitoring the aircraft systems, excluding those directly affecting the flight path (e.g. fuel, hydraulics, pressurisation). - Monitoring other operational factors affecting the flight (e.g. weather and traffic). - Monitoring the actions and condition of the on-board pilot. - Clearly alerting the on-board pilot if any deviations or inconsistencies are detected (e.g. aircraft actions don't agree with expected actions). - Monitoring the aircraft and on-board pilot regularly, deliberately, and systematically. - Cross-checking/cross-verifying information from multiple independent sources. - Maintaining the required level of vigilance for low and high workloads. - Performing all of the above for one or more aircraft with a single on-board pilot.	Beginner	Flight path monitoring. Human performance and limitations.
Aircraft Flight Path Management, automation	Controls the aircraft flight path through automation, including appropriate use of flight management system(s) and guidance. (IN THE EVENT OF PILOT INCAPACITATION ONLY)	- Automatic flight control systems. - Fly-by-wire (FBW). - Aircraft automation (autopilot, Flight Management System, auto-thrust, auto-land, etc.). - Flight envelope protection. - Aircraft performance. - Flight deck controls and displays (PFD, ND, ECAM, MCDU, FCU, etc.).	- Taking over control of the aircraft to divert to a suitable airport and land using the on-board automation only. - Detecting deviations from the desired aircraft trajectory and takes appropriate action. - Containing the aircraft within the normal flight envelope. - Maintaining the desired flight path and delegates other tasks to another ground pilot or to the supervisor. - Selecting the appropriate level and mode of automation in a timely manner. - Effectively monitoring automation, including engagement and automatic mode transitions.	Beginner	Automatic flight control and management. Aircraft performance.
Operation of Ground Control Station (GCS) tools/automation	Demonstrates effective use of GCS tools and automation to monitor and support flights with a single on-board pilot.	- GCS hardware and software. - GCS controls and displays (related to primary flight data, navigation, traffic, systems, weather, terrain, procedures/checklists, radios, etc.) - Similarities and differences between the GCS and the flight deck. - Communication link between the GCS, the aircraft and ATC. - Control and telemetry link between the GCS and the aircraft. - Multimodal interaction between the ground pilot and GCS (touchscreen gestures, voice commands, etc.). - GCS redundancy.	- Operating ground control station tools correctly, independently, and efficiently. - Using the right ground control station tools depending on the phase of flight. - Interacting with ground control station tools using the appropriate means of interaction (e.g. touchscreen gestures, voice commands, physical controls, etc.). - Using the ground control station tools to monitor the aircraft and on-board pilot and to communicate with the pilot and ATC. - Using the ground control station tools to manage the flight path of an aircraft in the event of on-board pilot incapacitation. - Monitoring the ground control station tools for correct operation (display of information, etc.). - Monitoring the integrity of the communication (voice & data), control and telemetry links between the GCS and the aircraft.	Beginner	Ground control station systems. AI-enabled automation and decision support systems. Cybersecurity.

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situation Awareness	Perceives and comprehends all the relevant information available and anticipates what could happen that may affect the operation.	- Aviation psychology (human information processing, human error and reliability, situation awareness, safety awareness, etc.) - Threat and error management - Aircraft general knowledge (systems, instrumentation) - Aircraft performance (climb performance, variables effecting aircraft performance in different phases of flight, etc.) - Surveillance systems (for weather, traffic and terrain avoidance)	- Identifying and assessing accurately the state of the aircraft and its systems. - Identifying and assessing accurately the vertical and lateral position of the aircraft and its anticipated flight path. - Identifying and assessing accurately the general environment (weather, traffic, terrain) as it may affect the operation. - Keeping track of time and fuel. - Maintaining awareness of the onboard pilot and his/her capacity to perform as expected. - Gathering information from all sources at his/her disposal and shares relevant information with the onboard pilot to ensure a shared mental model of the situation. - Anticipating accurately what could happen, plans, and stays ahead of the situation. - Together with the onboard pilot, developing effective contingency plans based on potential threats e.g. pilot incapacitation. - Together with the onboard pilot, identifying and managing threats to the safety of the aircraft and passengers. - Recognising and effectively responding to indications of reduced situation awareness. - Performing all the above for one or more aircraft with a single onboard pilot.	Beginner	Human performance and limitations Flight path monitoring
Communication	Demonstrates effective oral, non-verbal, and written communications, in normal and non-normal situations	- RT communications / RT phraseology (IFR and VFR) - Datalink systems (CPDLC, etc.) - Types of communication (verbal, non-verbal, etc.) - Effective communication techniques - Crew Resource Management (CRM) - Operational procedures	- Ensuring that the recipient (on-board pilot, ATCo, other ground pilot, etc.) is ready and able to receive the information. - Selecting appropriately what, when, how and with whom to communicate. - Conveying messages clearly, accurately, and concisely. - Confirming that the recipient correctly understands important information. - Listening actively and demonstrates understanding when receiving information. - Asking relevant and effective questions. - Adhering to standard radiotelephone phraseology and procedures. - Accurately reading and interpreting required company and flight documentation. - Accurately reading, interpreting, constructing, and responding to datalink messages in English. - Completes accurate reports as required by operating procedures. - Correctly interpreting non-verbal communication. - Using eye contact, body movement and gestures consistent with verbal messages. - Performing all of the above for one or more aircraft with a single on-board pilot.	Beginner	VFR and IFR communications Human performance and limitations
Workload Management	Manages available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.	- Aviation psychology (human overload and underload, fatigue, and stress management, etc.). - Threat and error management. - Time management / planning. - Multi-tasking strategies.	- Maintaining self-control in all situations. - Planning, prioritizing, and scheduling tasks effectively. - Managing time efficiently when carrying out tasks. - Offering and accepting assistance and asking for help early. - Reviewing, monitoring, and cross-checking actions conscientiously. - Verifying that task are completed to the expected outcome. - Managing and recovering from interruptions, distractions, variations, and failures effectively. - Performing all the above for one or more aircraft with a single on-board pilot.	Beginner	Human performance and limitations

Figure 9: Study Pathway for a New Entrant skilling to become a Groud Pilot.

2.4.2.3 Professional Commercial Pilot: Reskilling to single pilot onboard

The study pathway of the reskilling single pilot assumes that he/she has already the theoretical knowledge and practical skills of any licensed commercial pilot (ATPL/A). He/she is already able to fly large aircraft that transport many passengers. The study pathway will describe which additional knowledge and skills he/she needs to become a single pilot. It is assumed that SPO will occur on a different type of aircraft and will require a specific type rating. Moreover, the reskilling single pilot is already a captain in a major airline. Thus, he already has the knowledge and skills related to the specific functions of this status, as cabin crew and passenger management. Therefore, the study pathway of the reskilling single pilot is the same as the one of the new entrant single pilot, except for elements concerning the status of the captain.

PROFESSIONAL COMMERCIAL PILOT: Reskilling to single pilot onboard		
Formal Training		
	Main Topic	**Description of content**
	Theoretical knowledge about the new automated systems specific of SPO.	- Description of the functioning. - Logic. - Rules. - failure modes. - Context of utilization.
	Theoretical knowledge about the systems of the new type of aircraft.	- Description of the functioning. - Logic. - Rules. - Failure modes. - Context of utilization.

Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Theoretical knowledge about the procedures related to the new type of aircraft.	- Description of the procedures. - Context of use. - Prioritizing rules. - Philosophy of use.
	Theoretical knowledge of specific human factors issues related to automation pitfalls.	- Mode errors: when the pilot is not aware of the mode in which the automated system is functioning. - Complacency and over-reliance: tendency to trust excessively automation. - "Out of the loop" phenomenon: with reduction of situation awareness. - "Clumsy" automation: when automation adds complexity to a task.
	Theoretical knowledge of procedures of communication with the ground pilot.	- Phraseology associated to communications between onboard pilot and ground pilot. - Allocation of roles and responsibilities between onboard pilot and ground pilot.
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	**Main Topic**	**Description of content**
	Simulation training on the specific type of aircraft simulator.	- Checklists for simulated flight and operations. - Flight training preparation. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Briefing and debriefing with ground pilot or instructor. - Emergency simulation. - Hand-eye coordination. - Simulations of high workload situations.
	Real flight training on the specific type of aircraft with supervisor on-board.	- Operational procedures. - Application of theoretical knowledge. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Briefing and debriefing with ground pilot or instructor. - Hand-eye coordination. - Pre-flight preparation and inspection. - Flight in abnormal conditions. - Landing, missed approach. - Ends with the "release" of the single pilot.
	Real flight training on the specific type of aircraft with supervisor on ground.	- Operational procedures. - Application of theoretical knowledge. - Interaction with automated systems and ground pilot. - Decision making. - Situation awareness. - Briefing and debriefing with ground pilot or instructor. - Hand-eye coordination. - Pre-flight preparation and inspection. - Flight in abnormal conditions. - Landing, missed approach.

COMPETENCES (Select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
EX: Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Aircraft Flight Path Management, manual control	Controls the aircraft flight path through manual flight, including appropriate use of flight management system(s) and flight guidance systems.	-Systems functioning laws (including flight control laws: normal, abnormal, direct...) -Breakdown modes and consequences -Interactions between systems	-Controls the aircraft manually with accuracy and smoothness as appropriate to the situation. -Detects deviations from the desired aircraft trajectory and takes appropriate action. -Contains the aircraft within the normal flight envelope. -Controls the aircraft safely using only the relationship between aircraft attitude, speed and thrust. -Manages the flight path to achieve optimum operational performance. -Maintains the desired flight path during manual flight whilst managing other tasks and distractions. -Selects appropriate level and mode of flight guidance systems in a timely manner considering phase of flight and workload. -Effectively monitors flight guidance systems including engagement and automatic mode transitions.	Intermediate or advanced	Simulator and real flights with a focus on following training topics: - Flight path monitoring - Human performance and limitations
Application of procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge.	-Pre-requisites to procedures -Level of priority of procedures -The logic/philosophy behind each procedure -Possibility to delegate the procedure to the ground pilot or to the system	-Identifies the source of operating instructions. -Follows SOPs unless a higher degree of safety dictates an appropriate deviation. -Identifies and follows all operating instructions in a timely manner. -Correctly operates aircraft systems and associated equipment. -Complies with applicable regulations. -Applies relevant procedural knowledge. -Always checks his/her actions (close-loop procedure).	Intermediate or advanced	Studying, learning and practising on dedicated computer assisted training, with a focus on following training topics: - Operational procedures for ground pilots - Air law
Specific AI and automation knowledge related to the automated systems used in the single pilot aircraft.	Knows how and when to trigger or disable automation.	-The use, benefits and consequences of the automated systems and AI used in the single pilot aircraft -The limitations of AI and automation	-Use efficiently the automated systems and relieve his workload.	Advanced	Studying and learning + simulator and real flight practice, with a focus on following training topics: - use of specific and AI automated systems. - simulation of breakdown of specific AI and automated systems

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situation awareness	Perceives and comprehends all the relevant information available and anticipates what could happen that may affect the operation.	-Theoretical model of situation awareness. -Factors affecting situation awareness: workload, stress.	-Managing his/her activity and select adequate options (search of missing information or diverting to fall back decision).	Intermediate or advanced	Studying and learning with a focus on following training topics: - Human performance and limitations. - Flight path monitoring.
Problem Solving and Decision Making	Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes.	-Theoretical models of decision making in complex situations (e.g., naturalistic decision making). -Consequences of workload, stress and fatigue on quality of decisions.	-Seeks accurate and adequate information from appropriate sources. -Identifies and verifies what and why things have gone wrong. -Employ(s) proper problem-solving strategies. -Perseveres in working through problems without reducing safety. -Uses appropriate and timely decision-making processes. -Sets priorities appropriately. -Identifies and considers options effectively.	Intermediate or advanced	Studying and learning with a focus on following training topic: - Human performance and limitations.
Communication skills	Demonstrates effective oral, non-verbal and written communications, in normal and non-normal situations.	-Theoretical knowledge on communication with remote operators. -Importance of context sharing.	-Ensures the recipient is ready and able to receive the information. -Selects appropriately what, when, how and with whom to communicate. -Conveys messages clearly, accurately, and concisely. -Confirms that the recipient correctly understands important information. -Listens actively and demonstrates understanding when receiving information. -Asks relevant and effective questions. -Adheres to standard radiotelephone phraseology and procedures. -Accurately reads and interprets required company and flight documentation. -Accurately reads, interprets, constructs, and responds to datalink messages in English.	Intermediate or advanced	Role play, games, simulations, and real flights with a focus on following training topics: - VFR and IFR communication. Human performance and limitations.
Workload Management	Manages available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.	- Aviation psychology (human overload and underload, fatigue, and stress management, etc.). - Threat and error management. - Time management / planning. - Multi-tasking strategies.	- Maintaining self-control in all situations. - Planning, prioritizing, and scheduling tasks effectively. - Managing time efficiently when carrying out tasks. - Offering and accepting assistance and asking for help early. - Reviewing, monitoring and cross-checking actions conscientiously. - Verifying that tasks are completed to the expected outcome. - Managing and recovering from interruptions, distractions, variations and failures effectively. - Performing all of the above for one or more aircraft with a single on-board pilot.	Intermediate or advanced	Simulations and/or games with a focus on following training topic: - Human performance and limitations.

Figure 10: Study Pathway for a Professional Commercial Pilot reskilling to become a Single Pilot onboard.

2.4.2.4 Professional Commercial Pilot: Reskilling to ground pilot

The study pathway of the reskilling single pilot assumes that he/she has ample flying experience. Given the current job, the professional commercial pilot is assumed to have completed all theoretical knowledge subjects as well as flight training in both basic and complex aircraft. It is expected that, in the event of pilot incapacitation, the system will have enough redundancy to enable the ground pilot to use the onboard automation (e.g. autopilot, FMS) to land the aircraft safely i.e. it is not expected that the ground pilot will control/fly the aircraft manually, but rather use automation to control the aircraft if the need arises. It is also assumed that an experienced commercial pilot who undergoes reskilling to become a ground pilot may take up supervisory and leadership roles. In fact, the behavioral skills mentioned below take this into consideration. It is also assumed that, besides the technical and behavioral competencies mentioned below, the other competencies listed under the new entrant ground pilot are also required.

PROFESSIONAL COMMERCIAL PILOT: Reskilling to ground pilot		
FORMAL TRAINING		
	Main Topic	**Description of content**
	Automation systems: Flight Control and Management	- Autopilot - FMS - Autothrust - Autoland - Control laws and flight envelope protection
	Human Performance and Limitations	- Human information processing - Situation awareness - Threat and error management - Workload management - Crew Resource Management (CRM) - Automation issues
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Operational Procedures for ground pilots	- Tasks and responsibilities of the ground pilot - Flight preparation - Abnormal and emergency procedures related to onboard pilot incapacitation, loss of link etc - Ground pilot training requirements - Ground pilot duty time limitations and rest requirements - Minimum required equipment for ground control systems - Communication procedures - Handover procedures

required to being ex. Pilot	Ground Control Station System	- Communication, control, and telemetry links - Communication system - Controls and displays - Multi-modal user interaction (touch, voice, etc.) - Decision support systems (including AI-enabled support systems) - Alerting - Voice and data recording (both flight data and GCS data) - GCS redundancy requirements
	Monitoring & intervention	- Principles of effective monitoring and intervention - Aircraft performance and systems monitoring - Environmental monitoring (weather etc.) - Monitoring of the single on-board pilot
	Cybersecurity	- Cybersecurity threats in aviation systems - Common attack methods (hacking, spoofing, jamming, etc.) - Countermeasures (GNSS augmentation, anti-jam antennas, encryption, anomaly detection, etc.) - Threat detection and alerting - Emergency procedures
	Main Topic	**Description of content**
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying…	Advanced and Type Specific ground pilot training	This practical training will provide practical hands-on training on ground control systems and thus introduce the experienced commercial pilot to the tasks of the ground pilot. This training can be a combination of simulated scenarios and real-life scenarios involving real aircraft. Training should include both normal and abnormal scenarios with a special focus on all abnormalities related to the ground control station. This training should include the following: - Operation of the GCS hardware and software - Standard operating procedures of the ground pilot - Control and telemetry linking and integrity checking - Aircraft flight path monitoring - Various emergency scenarios such as o Aircraft powerplant and other technical malfunctions o Technical and/or medical diversions o Loss of communication with aircraft o On-board pilot incapacitation and subsequent takeover and safe landing by ground pilot. - Ground pilot handover procedures

COMPETENCES (select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of…***	***With this skill someone should be capable of….***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Aircraft flight path monitoring	Adequately monitor the aircraft's flight path.	Provide effective monitoring to the onboard pilot by following standard operating procedures and known if and when intervention is required.	Monitor both the aircraft systems as well as the onboard pilot adequately to ensure that the trajectory of the aircraft is as intended, and the aircraft is flying within its performance limitations.	Intermediate to advanced	Scenario based training of both routine and non-routine situations
Aircraft flight path management - automation	Controls the aircraft flight path through automation.	-Understand the various automation modes and different levels of automation. -Be able to choose the appropriate level of automation required for the situation. -Recognise when the automation is not behaving as expected.	-Controls the aircraft through the GCS using automation- -Recognizes any deviations from the desired aircraft trajectory and make any necessary corrections, including switching to a different automation mode or level. -Use appropriate automation modes and levels commensurate with the phase of flight and workload levels.	Intermediate to advanced	Scenario based training of both routine and non-routine situations. Training in automation use in abnormal scenarios, including several failed automation systems.
Computer skills	Understand and use computer systems.	Understand and use the various technical systems.	Be able to accomplish the tasks required using a multitude of computer systems and adapting to their use as required.	Intermediate	Experience and scenario-based training.

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of…***	***With this skill someone should be capable of….***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Leadership and Teamwork	Demonstrate effective leadership and ability to work in a team	Understanding of team dynamics and effective leadership techniques	-Using initiative and directing and delegating tasks when required. -Understanding all roles and responsibilities within the team. -Encouraging open communication and participation. -Taking responsibility for all actions and admitting mistakes when required. -Understanding team members' needs as well as differing levels of proficiency amongst team members. -Providing timely constructive feedback to team members whilst receiving and acknowledging the same from others. -Assertively intervene when required. -Resolving conflicts and/or disagreements constructively. -Projecting self-control even in distressing situations.	Intermediate to advanced	Experience, and a training programme like the commander training course.
Problem solving and decision making	Identify risks and problems and resolving them accordingly. Use appropriate decision-making processes.	Effective Decision-making processes and problem-solving strategies	-Seeking accurate information from appropriate sources. -Identifying and verifying why something has gone wrong. -Being aware of the risk of succumbing to confirmation bias. -Being resilient to difficult situations to find solutions and improvise if required in unforeseeable circumstances. -Prioritise tasks accordingly. -Identify and consider all options in an effective manner. -Monitoring, reviewing, and adapting decisions if required	Intermediate to advanced	Experience and scenario-based training of unforeseeable events.
Sensemaking	Be able to structure the unknown by processing various inputs and thus enable the individual to comprehend, understand and predict situations.	Knowledge of situational awareness requirements, as well as a sound technical knowledge of all aspects.	-Processing all incoming data from the GCS, the onboard pilot, and any other information available to make sense of the situation. -Building up a clear picture of the onboard situation despite not being physically present on board.	Intermediate	Scenario based training abnormal scenarios, in which the ground pilot must understand to accurately build a picture of the situation on board.

Figure 11: Study Pathway for the reskilling Professional Commercial Pilot to a Ground Pilot.

2.4.3 Airport Operations Study Pathways

Considering the two personas developed for the Airport Operations, two study pathways were developed:

- New Entrant Check-in Agent: Skilling
- Professional Check-in Agent: Upskilling and Reskilling

Each study pathway was designed considering the personas context and pre-existence knowledge and skills, which are the starting point assumption from building the study pathway focusing on the skilling, reskilling, and upskilling for the future scenarios.

Finally, in order to let explore in more detail the study pathway, the reader can find a link in each Study Pathway Figure Legend that lead to the study pathway independent document.

2.4.3.1 New Entrant Check-In Agent: Skilling

The passenger check-in process differs depending on the check-in mode chosen, the number of bags checked, and the airline the passenger has chosen to fly with. Check-in's objectives are:

• Controlling some of the revenue-generating transactions of the airline (Example: Checking whether each passenger has paid for their ticket, etc.)

• Checking the number of passengers for loading and seating purposes.

• Checking passenger baggage weights in accordance with the loading purpose.

• Placing the passengers on the plane according to the loading principles of the plane.

• Passenger identification

• Health, passport and visa control

• Giving the passenger seat number, producing boarding pass and baggage tags

• Checking the limits

• Special service for the passenger.

Check-in process is carried out in the following stages:

• Counter opening

• Welcoming the passenger

• Passenger identification

• Control of travel documents

• Checking the flight coupon

• Checking the name of the passenger from the PNL (Passenger Name List)

• Accommodating passengers

• Making the necessary entries on the flight coupon

• Receiving a valid voucher for the flight

• Preparation of boarding pass.

• Baggage acceptance

- Manifest preparation
- Closing the counter.
- General administration duties.

NEW ENTRANT CHECK-IN AGENT: Skilling		
FORMAL TRAINING		
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	**Main Topic** **Description of content**	
	Introduction to airport and airline operations	
	Communication (virtual/Online)	
	Passenger Services Training	
	Computer Reservations (CRS) and Departure Control Systems (DCS) functions	
	Offsite Passenger and Baggage check-in procedures	
	Dangerous Goods regulations awareness for passenger service agents	
	Lost Baggage / World tracer Management Training	
	Travel Documents Training	
	Aviation security procedures for passenger and baggage transport	
	Disabled Passengers and Transfer	
	Main Topic	**Description of content**
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	Check-in procedures and implementation of procedures	• Usage of electronic ticketing systems and virtual check-in systems • Customer documentation requirements • Aircraft seat configurations for different aircraft types
	Process management in check-in operations	• Having sufficient knowledge about electronic ticket systems and troubleshooting when necessary • Having sufficient knowledge about self-service check-in systems and troubleshooting when necessary • Providing necessary services for passengers with special needs • Airport emergency plans • Airport evacuation procedures • Overbooking flights
	Reviewing check-in processes and harmonizing them with international standards	• International regulations and policies for check-in procedures • Minimum Connecting Time (MCT) • Self-service kiosks • Bag-drop facilities • Multilateral Interline System and passenger tariffs

COMPETENCES (select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Language	Ability to speak and understand the English language	Should have language competence to communicate with passengers in all situations	To provide the necessary communication with all passengers in all situations.	Beginner	Studying and learning from the theoretical course; practical training
Airline Computer Reservation Systems	Computer reservation systems, or central reservation systems (CRS), are computerized systems used to store and retrieve information and conduct transactions related to air travel, hotels, car rental, or other activities.	Should be able and willing to type and learn airline specific computer systems	The individual should be able to use this system.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training
Dangerous Goods Regulations	Dangerous goods are articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in these Regulations, or which are classified according to these Regulations.	The individual should have knowledge of Dangerous Goods and Regulations.	With this skill, someone should be able to do the necessary operations in accordance with all regulations on dangerous substances.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training
Airport Emergency Plans	The airport emergency planning sets for the procedures for coordinating the response of different airport agencies (or services) and those agencies surrounding community that could be of assistance in responding to the emergency. operations and other activities conducted at the aerodrome.	The individual should have information about the current airport emergency planning procedures. Agent should also have detailed information about how it fits into the emergency plan.	With this skill, when someone encounters emergency and unexpected situations, they can act in accordance with the airport action plans. it can also direct itself and the passengers and personnel around it and related technological systems according to the emergency action plans.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training or basic and refreshing.
Travel Documents	Some form of identification is required, regardless of the length of your journey or the destinations that you're flying between. For international flights, you're required to bring a passport. For domestic flights, you do not need to bring your passport but will need some form of government-issued identification. Some airlines will allow you to bring two pieces of non-photo identification that match the name and date of birth on your reservation. Whereas others will request that you must bring a photo ID with the name and date of birth matching your reservation.	The individual should have knowledge of such as identity card, temporary identity card document, driver's license, passport and/or document used as a passport / legal/official document accepted as a passport by the issuing nation, marriage certificate, birth certificate (For infants up to one month old, along with parents' identification), photographed, sealed/stamped documents with identity number.	With this skill, someone should be able to recognize all listed travel documents, be able to check these documents and inform authorities when necessary.	Beginner	Studying and learning from the theoretical course; practical training

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Electronic ticketing systems	An e-ticketing system is a reservation in an airline's computer system and notifies passengers that you have a confirmed ticket seat on a particular flight. There is also an e-ticket receipt that is printed later when you issue an e-ticket.	The individual should have knowledge of Electrical Ticketing Systems and how they are used.	With this skill, someone should be able to assist the customer during the electronic ticket purchase process and answer any questions from customers about the system.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training
Self-service check-in systems	check-in by phone: passengers check in by phoning the airport; the boarding pass can be sent to a mobile phone or email, or it can be picked up at the airline service desk. web check-in: passengers check in at the airline website and print their boarding pass themselves; baggage is left at a baggage drop-off desk at the airport. mobile phone check-in: passengers check in by mobile phone and receive their boarding pass electronically; baggage is left at a baggage drop-off desk at the airport. airport check-in kiosk: passengers use computer terminals to check in at the airport; the boarding pass is printed on the spot and the baggage is left at a nearby baggage drop-off desk.	The individual should have knowledge about self-service check-in systems and have detailed information about the use of all self-service check-in systems.	With this skill, someone should be able to give advice about the system in line with the requests from the passengers or help with systemic problems.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training
IATA standards	IATA regulates and publishes standards in order to ensure that the services and operations offered at airports that carry out cargo and passenger transportation by air in all member countries are carried out with a certain quality, course and efficiency.	The individual should have knowledge of all standards and regulations of IATA regarding passenger services.	- With this skill, someone who should apply the existing IATA standards and provide services within the framework of these standards in response to the passenger demands.	Intermediate to Advanced	By learning IATA standards
Boarding on overbooked flights	An overbooked flight is when an airline sells more tickets on the plane than there are seats. This is a way to avoid empty seats from no-show passengers or missed connections. Provide explanations to dissatisfied customers or passengers who are denied boarding on overbooked flights	The individual should have knowledge of overbooked flights.	When overbooked on the flight, he / she should be able to explain this situation to the passenger and manage this situation without any problems.	Beginner to Intermediate	Studying and learning from the theoretical course; practical training

Figure 12: Study Pathway for skilling a New Entrant Check-In Agent.

2.4.3.2 Professional Check-In Agent: Upskilling and Reskilling

As mentioned in the New Entrant Study Pathway, when considering the professional check-in agent, we need to be aware that the check-in process differs depending on the check-in mode chosen, the number of bags checked, and the airline the passenger has chosen to fly with. Also the Check-in agent goals presented above must be considered when analysing the professional check-In agent study pathway.

PROFESSIONAL CHECK-IN AGENT: Upskilling and Reskilling	
FORMAL TRAINING	
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	**Main Topic Description of content**
	Travel Documents Training
	Offsite Passenger and Baggage check-in procedures
	Dangerous Goods regulations awareness for passenger service agents
	Aviation security procedures for passenger and baggage transport
	Cyber security
	Main Topic Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	Reviewing check-in processes and harmonizing them with international standards
	Airport emergency plans
	Airport evacuation procedures
	Minimum Connecting Time (MCT)
	New technologies/systems and check-in procedures
	Teamwork skill

COMPETENCES (select 3 to 5 to each group)					
Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Airport Emergency Plans	It is prepared in advance to help everyone cope after an emergency or disaster. The airport emergency plan (AEP) aims to support airports in defining roles and responsibilities during emergencies, identifying threats, and establishing communication protocols for the airport community.	-They should know their responsibilities during and after the disaster. -Know the list of key persons to be notified in an emergency. -He/she should know the methods of communication and notification procedures including the order in which persons are informed. -It should be aware that there are specific checklists for different scenarios, and they will be implemented. -Knowing the processes how and when information will be disseminated to the public, including who will speak to the media and what information will be published, with particular attention to sensitive information. -They should know local and national sources of assistance, as well as evacuation and accommodation techniques. -They should have knowledge of how to secure the area, how people enter and leave hazardous areas and sensitive information areas. -Should have the necessary knowledge about firefighting and medical assistance. -He / she should know how to access information about airport maps, building locations and airport ground information. -Should have information on places such as emergency meeting points and shelters.	With this skill someone should be able to do first aid treatment of bleeding, bruises and abrasions. Should follow the instructions in the created manuals to manage emergency operations. Should know which communication channels to use in emergency operations. Should know the location and use of special emergency equipment related to the tasks assigned to her in an emergency.	Beginner to advanced	Studying and learning from the theoretical course; practical training, live exercise

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Teamwork	Operation in aviation does not work with individual processes. It always requires teamwork.	-Contribution of teamwork to individuals and institutions. -Team formation, distribution of tasks. -Team leadership, synergy and common goal setting. -Providing effective communication skills inside and outside the team. -Motivating techniques. -Effects of collective intelligence. -Developing weaknesses in teamwork.	-Communicate constructively. -Should be an active listener. -Should act as an active participant. -Should openly and voluntarily share what he knows. -Should cooperate and be open to help. -Should be flexible. -Should be tied to the team. -Should be successful in solving problems.	Intermediate to Advanced	Studying and learning from the theoretical course; practical training
New technologies and systems	It is very important for both passengers and airline companies by increasing check-in efficiency. Increasing new technologies in check-in process reduce capacity problems and allow passengers to spend more time in the airport. There are new technologies such as Auto Check-in, Online Check-in, Early Bag Stores (EBS), Hold Baggage Screening (HBS), Auto baggage build that aim to improve flow through Check-In.	It is necessary to be a good computer user to use and follow the new technological innovations used and to be used in the airport.	With this skill, one should be able to use auto check-in, online check-in, Early Bag Stores (EBS), Hold Baggage Screening (HBS) and Auto baggage systems and assist passengers in their use, and be able to find solutions when problems arise with these new technologies.	Intermediate to Advanced	Studying and learning from the theoretical course; practical training

Figure 13: Study Pathway for upskilling and reskilling a Professional Check-In Agent.

2.4.4 RPAS Study Pathways

Considering the three personas developed for the RPAs, three study pathways were developed:

- New Entrant Remote Pilot: Skilling
- Professional Remote Pilot in the Open Category: Upskilling for specific/certified category
- Professional Remote Pilot in the Specific Category: Reskilling to fly optionally piloted aircraft / air taxis in the context of U-space operations

Each study pathway was designed considering the personas context and pre-existence knowledge and skills, which are the starting point assumption from building the study pathway focusing on the skilling, reskilling, and upskilling for the future scenarios.

Finally, in order to let explore in more detail the study pathway, the reader can find a link in each Study Pathway Figure Legend that lead to the study pathway independent document.

2.4.4.1 New Entrant RPA: Skilling

This pathway will focus on the technical and behavioural competences that will take a new entrant remote pilot from close-to no knowledge up to the professionalization of the person. It will look mainly at the electrically propelled UA. Regardless, novel propulsion systems, automation and artificial intelligence are considered in the study pathway.

This study pathway was created based on a new entrant remote pilot in the open category persona. (S)He represents many hundreds of people who have no technical skills, having finished their high-school, and are looking for some acknowledgment and easy access to a salary by doing something that they love – flying their drones, editing the videos and posting them online. Furthermore, it covers new entrants with close to zero experience in the topic, and who will face a significant change in responsibility, with the end goal of flying small drones/UA commercially as a service type operation for clients.

NEW ENTRANT REMOTE PILOT: Skilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Regulations and Air Safety	- Introduction to EASA and the aviation system; - Regulation (EU) 2019/945 and Regulation (EU) 2019/947 (or other Vigeant at time) - National Regulation applicable to UAS - Subcategories in the "open" category and the associated classes of Unmanned Aircraft Systems (UAS) - Registration of UAS operators - The responsibilities of the UAS operators and remote pilot - Incident / accident reporting - Airspace restrictions - Introduction to U-space - Operation in Visual Line of Sight (VLOS) - Insurance - Security - Environment protection. noise, lost hazardous parts and protection of wildlife and its cycles
	UAS General Knowledge	- Information obtained from the UAS manual - Understanding of the UA's capabilities and limitations - Control basics (e.g., hierarchies, loops, rules, observation and actuator variables) - Artificial intelligence, automation and flight modes - Novel propulsion systems and energy sources (e.g., fuel cells, new batteries) - Changing and discharging of batteries - Safety concerns to operators and other people hazards - Aerodynamics and propulsion (specific to the type of UA) - Mass and Balance - Performance - Electric and electronic components - Principles of automatic flight - Datalinks and telecommunication - Lost link procedures and pre-flight configurations for safe return to land - GNSS and localization - Loading and update of geo-fences and awareness zones - Payload operation
	Operational Procedures	- Surrounding environment analysis, including terrain, airspace, people, buildings, electromagnetic interferences and jamming - Meteorology and limitations imposed on the flights - Databases and accesses - where and how to consult the required updated information - Briefing and debriefing - Pre/post flight inspections - Flight planning - Take-off and landing planning - Contingency planning - Air Navigation - Overflight of uninvolved people - Maintenance - Procedures in case of unintended operation near other aircraft MEUH method: Meteorology, Environment, UAS, Human
	Human Performance and Limitations	- Fit to fly self-analysis - IMSAFE assessment methodology - Limitations on perception (depth of field, distance/height to/from the UA, speed of the UA, night operations) - Disorientation - Stress, arousal and fatigue – detection and mitigation Error management and mitigation
	Privacy and data protection	- Regulation of privacy and data protection Authorizations for image viewing, recording and dissemination
	Risk Assessment and Management	- Risk and danger definition - Methodologies for assessing risk - Risk management and mitigations - Safety concerns to operators and other people hazards - Security

	Main Topic	Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	Simulation Training	- Situational awareness training - Interaction with UAS software, firmware, and hardware - Checklists for simulated flight and operations - Flight planning and preparation according to theoretical training and knowledge - Decision making - Briefing and debriefing - Hand-eye coordination - Simulated flight training - Emergencies and contingency
	Initial and intermediate practical real-flight training on basic UA (if final UA operations is heavier or much more complex)	- Operational procedures - Application of theoretical knowledge - Interaction with the UAS, safety precautions, performance and limitations - Familiarization with the operating environment, how to perform the evaluations of the presence of uninvolved people in the overflown area. Identification of obstacles and hazards. - Preparation for flight and checklists - Flight and contingency planning - Pre-flight preparation and inspection - Flight instruction, including all parts of the flight, flight modes and maneuvers - Keep the UA outside of no-fly or restricted zones - Perform return to home/land point manually and automatically - Emergency simulations during flight - Control distance to/from obstacles and people - Exercise good judgment and airmanship - Maintain control of the UA at all times in such a manner that the successful outcome of a procedure or maneuver is never seriously in doubt - Return the UA to the remote pilot after it has been flown to a location far enough not to distinguish the orientation of the UA - Landing, missed approach and return for landing - Flight in abnormal conditions - Decide and act on a situation of loss of attitude or position caused by internal and external phenomena - Simulation of temporary loss of control, either by internal failure or datalink loss, and consequent failsafe activation - Debrief and flight logs - Post-flight inspections - Maintenance
	Real-flight training on operational UA	- Familiarization with the UA, safety precautions, performance and limitations - Methodic application of operational procedures and theoretical knowledge - Airspace segregation and other airspace limiting factors, including air safety - Familiarization with the operating environment, how to perform the evaluations of the presence of uninvolved people in the overflown area. Identification of obstacles and hazards - UAS meets technical requirements of the geographical zone - Assessment and evaluation of meteorological conditions and their impact on the operation - Flight briefing, preparation and checklists - Flight and contingency planning - Pre-flight preparation and inspection - Flight instruction, including all parts of the flight, flight modes and maneuvers - Emergency simulations during flight - Control distance to/from obstacles and people - Exercise good judgment and airmanship - Maintain control of the UA at all times in such a manner that the successful outcome of a procedure or maneuver is never seriously in doubt - Operational standard scenario simulation

COMPETENCES (select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Hand-eye coordination & UA flight path control and management	Coordination of necessary in-flight manoeuvres with intended and hand commands and automation processes. Coordination of the flight path, maintaining proper guidance, and appropriate distance to obstacles, terrain and people.	-How a handset/RC remote typically works, in terms of inputs and common outputs of the UA. -Typical UA dynamics in 3D space.	-The individual should be able to accurately fly the UA in VLOS and FPV (video - first person view) operations. Capable of coordinating his intentions with the proper drone control. -Performing proper, steady, coordinated flights and operations, controlling the various payloads in a correct manner.	Beginner to Intermediate	-Understanding of the UA flight performance, capabilities and limitations. -Practical (both simulated and real) flights in various weather conditions within the limitations of the UA; Operation in abnormal conditions.
Application of Procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge (Source: EBT ICAO).	-The importance of understanding and following procedures. -The importance of regulations and rules of the air.	-Understanding the rules and restrictions applicable to the operation of the UA, in different locations and scenarios. -Collect and assess proper information about airspace limitations and segregation. -Fulfil all requirements in terms of licences and requests necessary for the operations.	Beginner to Intermediate	Studying and learning from the theoretical course; applying the theoretical knowledge to the location/scenario of the operation.
Assessment of operational scenario	Capable of assessing the operational scenario of the operations, prior to and during the flight. Capable of adjusting flight path and control over the UA to changing conditions.	The importance of being alert to the external factors affecting an operational scenario.	-The remote pilot should be able to properly identify the limiting factors of the foreseen scenario of operation, including: overflight of people, buildings, airspace limitations, weather, take-off and landing zones, contingency zones (MEUH). -To understand clouds in the sky, their type and movement, understand the wind in trees or on the water, infer uses for different zones in the scenario, including buildings, people actions and movement".	Beginner to Intermediate	Studying and learning from the theoretical course; attention to detail and all aspects comprising a given scenario; practical training, in normal and abnormal conditions.
Risk assessment and safety-based judgement	The ability to identify and rank risks, to determine which are critical and above the risk tolerance or threshold and thus require attention, and then to select the risk management action(s) to take in response.	Risk assessment of the operational scenario, limiting factors and status of the UA.	Establish hierarchies of priorities according to the mission and MEUH, define "go/no go" and "return-to-home" conditions, forbidden areas or actions based on MEUH.	Beginner to Intermediate	This skill is highly dependent on the knowledge and attitude of the remote pilot; it will depend on intrinsic factors, like the boldness of the RP to take risks and to consider risks with low probability of occurring as being risk that should be acknowledged and mitigated. The trainees should be aware of the safety behaviours and trained of how they can follow them on the field. The training should have a practical component with case studies from real pilot situations and even with on-field training

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situational awareness	The ability to perceive and comprehend all of the relevant information available and anticipates what could happen that may affect the operation (s: ICAO EBT).	Factors affecting situational awareness of external factors and UA statuses. Additionally, the RP should be able to place identify the correct location and trajectory that the UA should take to perform the desired action 3D space.	-Performing solid navigations in 3D space and manage both external factors that have changed during the flight, as well as internal status of the UA (e.g., low battery, loss of link, geofence violation, inability to control payload). -The RP should also be capable of performing proper, solid and precise navigation of the UA in 3D space.	Beginner to Intermediate	This skill is dependent on the capability of absorbing and paying distributed attention to several factors extrinsic and intrinsic to the UA. This skill can be acquired by training distributed attention during daily activities, as well as simulated and real flying/training.
Problem solving and Decision making (with focus on stress management)	Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes (s: ICAO EBT).	Coping strategies for stress, anxiety, and doubt, in order to properly decide on a situation, using rational and balanced decisions; Additionally, the RP should demonstrate humility, recognize his errors, and be able to learn from them in a constructive and positive way.	-Keep still when facing disturbances: orally explain possibilities and elaborate troubleshooting process to understand abnormalities in flight and final decision making. -Review and improve past decision during debriefing.	Beginner to Intermediate	This skill is deeply connected to the attitude and personal behaviour of the RP. Nevertheless, it can be trained by stimulating stress and forcing the RP to cope with it during simulated and real operations. This skill is also dependant on the experience of RP.
Analytical Capability	Ability to collect and analyse information, problem-solve, and make decisions.	Basic forms of processing information and channelling it to perform sensemaking and logic-related tasks.	-Properly managing and prioritizing the several the stimuli received from all five senses, which can be provided by the surroundings, internal to the UA system, instructor or other team members. -The RP should be capable of processing information from different sources in well organized, priority- based management strategy. -This information can come be provided to all five senses of the RP.	Beginner to Intermediate	This skill can be trained in classroom where we can assess the individual's level and present different techniques to analyze information. The simulation will be the practical exercise, where information with different priorities is provided via stimuli to all five senses.
Adaptability to Change	Adaptability means one is able to quickly respond to changing factors, e.g., trends, innovation, destabilization, industry shifts.	Coping well and adapting to changing conditions and scenarios.	The RP should be capable of quickly and efficiently respond to changes in the surrounding and be flexible in adaptation to new contexts. Expose the RP to sudden changes such as mission modification, technical issues, wind changes (prepare mission at 150ft and fly at 350ft).	Beginner to Intermediate	This skill can be trained in classroom to recall scenarios exercises. The practical training is complementary to the simulation exercises on Situational Awareness.

Figure 14: Study Pathway for skilling a New Entrant Remote Pilot.

2.4.4.2 Professional Remote Pilot in the Open Category: Upskilling for specific/certified category

This pathway will focus on the technical and behavioural competencies required to upskill an already professional remote pilot (RP) in the current open category and provide him with the tools and skillset to become an RP in the specific category.

The persona on the basis of the study pathway was created to represent an already experienced RP in the open category, who has considerable experience in the operation of light multi-rotor multi-purpose drones.

Professional Remote Pilot in the Open Category Upskilling for Specific/Certified Category		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Air Law	- Introduction to EASA and the aviation system - Regulation (EU) 2019/945 and Regulation (EU) 2019/947 (or other Vigeant at time) - National Regulation applicable to UAS (which may differ from International) - U-Space - Unmanned Traffic Management (UTM) - Airspaces - Insurance - Responsibilities of the Unmanned Aircraft Systems (UAS) operators and remote pilot - Registration (Operator, Remote Pilot and Aircraft) - Rules of the air - Procedures for air navigation services - Air Traffic Services (ATS) and Air Traffic Management (ATM) - Aeronautical Information Services (AIS) - Aerodromes - Mandatory and voluntary reporting
	Principles of Flight	- Physics, Bernoulli's law, conservation of mass - Speed of sound - Dynamic, Static and total Pressure, Lift and Drag Airspeeds (IAS, CAS, TAS, GS) - Airfoils (camber, chord, thickness and ratios) - Forces acting on an airplane - Turning and accelerated flight - Primary and secondary flight controls - Stall - Stability (long and lateral, static and dynamic stability) - Flight limitations and envelope - Flight in adverse weather conditions - Speed of sound
	Performance	- Stages of flight - Factors affecting performance - Speed definitions - Takeoff, Climb, Cruise, Descent and Landing performance (in the case of multi-engine Performance with one engine inoperative)

	Aircraft Systems	- Mainframe, wings, tail, canards, control surfaces - Powerplants and accessories; powerplant limitations (RPM, blade tip speed, ice, high temperatures) - Electrics and electronics - Landing gear - Surveillance and ATC systems: GNSS, ADS-B, SSR and Transponder, Laser altimeter
	UAS General Knowledge	- Unmanned aircraft: types of UA, flight characteristics, limitations, operational limitations - Autopilot flight modes: manual, fly-by-wire, automatic (altitude hold, heading based, waypoint based), autonomous; control laws and flight envelope protection - Ground control station: introduction, configurations, crew specifications - Datalink: frequencies, jamming, limitations, power, omni-vs-direct antennas - Payloads: electro-optic visible, infra-red and stabilized cameras, synthetic aperture radar, magnetometer, range finder, Field of View,
	Mass and Balance	- Center of Gravity - Datum line - Balancing of an aircraft - Effects of CG shift forward and aft - Types of fuel and respective calculations
	Navigation and Flight Planning	- Principles of navigation - Latitude and Longitude - Types of Charts and cartography - Meridians and Rhumb lines - Satellite Navigation: types, signal frequencies and carriers, constellations, DOP, signal augmentation, real time kinematics and differential GPS - Inertial Navigation - Dead Reckoning - Flight planning - Take-off and landing planning - Contingency planning - Lateral and vertical navigation - Airspace reservation
	Weather	- The atmosphere, pressure, temperature and density with altitude - Wind - Coriolis effect - Precipitation - Pressure systems - Types of clouds - Fronts and respective characteristics - Ice formation conditions - Forecast and report - METAR, TAF, SPECI - QNH, QNE, QFE - Altimetry - Low level charts - Regional weather phenomena
	Operational Procedures	- Responsibilities of the RP - Surrounding environment analysis, including terrain, airspace, people, buildings, electromagnetic interferences and jamming - Meteorology and limitations imposed on the flights - Databases and accesses - where and how to consult the required updated information - Requirements of GCS, regarding minimal operational statues and backups - Briefing and debriefing - Checklists - Pre/post flight inspections - Flight preparation forms to be completed before flight - Overflight of uninvolved people - Maintenance - Procedures in case of unintended operation near other aircraft - BVLOS operations - Notions of Low visibility operations - Handover procedures - Emergency procedures - MEUH method: Meteorology, Environment, UAS, Human - Duty times - Operational Authorization Process - Mandatory and voluntary reporting - Remote pilot logbook, maintenance records and other documentation - Notice to airmen (NOTAM) - Aeronautical Information Publication (AIP) - Emergency Response Plan (ERP) - Dangerous goods
	Communications	- U-space and UTM communication procedures - ATM procedures - SSR and transponder codes - Communication in phonetic alphabet and numbers - Phraseology - Weather information - Reporting - Procedures for loss of communications and data link - Distress phases and procedures
	Human Performance and Limitations	- Human sensing - Biases of remote/teleoperation when interpreting the sensors displayed in the GCS, including lags, delays and misinterpretation - Rest cycles - Workload management - Safety awareness - Threat and error management - Fit to fly self-analysis - IMSAFE assessment methodology - Limitations on perception (depth of field, distance/height to/from the UA, speed of the UA, night operations) - Perception; Disorientation and Attentiveness - Stress, arousal and fatigue – detection and mitigation - Decision-making
	Security, Privacy and data protection	- Cybersecurity and good practices - Privacy and data protection for collected contents - Common attack methods, incl. hacking, GPS spoofing, jamming - Threat detection
	Crew Resource Management / Multi-crew coordination	- Crew resource management techniques - Different types of personalities - Handling incorrectly perceived information - Tasking, coordination and commands within hierarchy - Airmanship - Leadership

	Safety, Risk assessment and management	- Remote Pilot and crew qualifications - Probability of failure - System Risk assessment - Maintenance procedures - Operational risk assessment for air and ground risk - Mitigation strategies - Presenting risk assessment to authorities for permit to fly issuance - Introduction to Specific Operations Risk Assessment (SORA) and overview of Standard Scenarios (STS) and Predefined Risk Assessment (PDRA)

	Main Topic	Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	Simulation Training	- Adapting to the simulator, GCS and UAV dynamics - Interaction with UAS software, firmware, and hardware - GCS cockpit layout, instruments and displays (PFD, ND, EICAS, overhead panel, central pedestal, standby instruments, radios, etc.) - Location and interpretation of commands, options and warnings on GCS - Interpretation of sensor data and operational limits of each parameter - Flight planning (pre- and during flight) - Monitoring flight parameters, incl. flight modes, path, altitude, speed, temperatures, weather, datalink, instruments, transponder and ADS-B, backups, batteries, fuel, warnings, ATC coordination, geo-fencing - Situational awareness - Low level operations - Decision making - Briefing and debriefing - Hand-eye coordination - Simulated flight training - Emergencies and contingency - Training crew coordination - U-space integration, procedures and new rules of the air - Perception of sense and avoid, interpreting sensors and automatic collision avoidance - ATC communication practice - Changing ATC jurisdiction and type of airspace
	Real-flight training	- UA manuals, UA status, logbook, anomalies, - Operation of GCS Hardware and Software - Aircraft performance and limitations - Crew management and coordination (with external pilot, take-off technician) - Interpretation of sensor data and operational limits of each parameter - Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) - Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications - Monitoring of the aircraft's systems (fuel, electrics, etc.) based on GCS data and pilot communications - Standard Operating Procedures (SOPs) - Briefing and debriefing - Notions of Flight procedures (before start, start, taxi, before take-off, (rejected) take-off, climb, operations, descent, approach, missed approach, landing, after landing, taxi and parking) - Adapting flight to weather, ATC, operational limitations and other contingencies - Situational awareness - Low level operations - Communicating with other crew (e.g., payload operator, mission director) sharing and coordinating information - Decision making - Hand-eye coordination - Emergencies and contingency
		- U-space integration, procedures and new rules of the air - Perception of sense and avoid, interpreting sensors and automatic collision avoidance - ATC communication - Changing ATC jurisdiction and type of airspace - UA control handover to another RP in the same GCS - UA handover to another GCS - Cyber- and data-link security, data protection

COMPETENCES (select 3 to 5 to each group)

Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Operation of GCS, UA flight path control and management, automation	Coordination of necessary in-flight manoeuvres with intended commands and automation processes. Coordination of the flight path, maintaining proper guidance, and appropriate distance to obstacles, aircraft, terrain and people, while interpreting the GCS sensors and indicators	-GCS hardware and software. -Communication link between the GCS, the aircraft and ATC. -Control and telemetry link between the GCS and the aircraft. -Typical UA dynamics in 3D space. -Types of automation typically present in a UA (tele-operation with stick and pedals, handset operation, remote fly-by-wire, automatic waypoint-based navigation, course navigation altitude hold, position hold. -How to conceptually avoid entering limited zones and avoiding conflict and risky situations by properly controlling the UA to avoid the areas (divert/heading change, climb, (de)increase airspeed.	-Operating GCS tools correctly, independently and efficiently. -Using the right ground control station tools depending on the phase of flight. -The individual should be able to accurately fly the UA in BVLOS and FPV (video - first person view) operations. Capable of coordinating his intentions with correct UA control. -Performing proper, steady, coordinated flights and operations, by selecting the proper flight mode and command at all times. -Interpreting and coping with AI flight modes in a correct manner	Intermediate to advanced	-Understanding of the UA flight performance, capabilities and limitations. -Familiarization with GCS/cockpit and UA flight modes. -Training and practising all allowed flight modes. -Practical (both simulated and real) flights in various weather conditions within the limitations of the UA; Operation in abnormal conditions.
Application of Procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge (Source: EBT ICAO)	The importance of understanding and following procedures. The importance of regulations and rules of the air. The consequences of not following or understanding the procedures.	Understanding the rules and restrictions applicable to the operation of the UA, in different locations and scenarios. Collect and assess proper information about current and future status of the UA, airspace limitations and segregation. Fulfil all requirements in terms of approvals and requests necessary for the operations.	Intermediate to advanced	Studying and learning from the theoretical course; applying the theoretical knowledge to the location/scenario of the operation. Being informed by the instructors about the reasoning behind the procedures and the consequences of not following them in terms of safety and security.

Assessment of operational scenario	Capable of assessing the operational scenario of the operations, prior to and during the flight. Capable of interpreting the current and future status of the operational scenario based on flight planning, briefing information and current observations. Capable of adjusting flight path and control over the UA to perceived changing conditions.	The importance of performing scrutinous data collections (briefing, weather, flight planning, and contingencies) prior to the flight. The importance of being alert to the external factors affecting an operational scenario, and interpreting the information provided from the UA, in light of the pre-flight briefing data.	The remote pilot should be able to properly identify the limiting factors of the foreseen scenario of operation, including: overflight of people, buildings, airspace limitations, weather, take-off and landing zones, contingency zones (MEUH). To understand wind, clouds in the sky, their type and movement, water, infer uses for different zones in the scenario, including buildings, people actions and movement.	Intermediate to advanced	Studying and learning from the theoretical course; attention to detail and all aspects comprising a given scenario. Comparing the influence of a misinterpretation of the pre-flight information bulletin/briefing. Practical training, in normal and simulated abnormal conditions.
Risk assessment and safety-based judgement	The ability to identify and rank risks, to determine which are critical and above the risk tolerance or threshold and thus require attention, and then to select the risk management action(s) to take in response.	Risk assessment of the operational scenario, limiting factors and status of the UA	Establish hierarchies of priorities according to the mission and MEUH, define "go / no go" and "return-to-home" conditions, forbidden areas or actions based on MEUH	Intermediate to Advanced	This skill is highly dependent on the knowledge and attitude of the remote pilot; it will depend on intrinsic factors, like the boldness of the RP to take risks and to consider risks with low probability of occurring as being risk that should be acknowledged and mitigated. The trainees should be aware of the safety behaviours and trained of how they can follow them on the field. Training should have a practical component with case studies from real pilot situations and even with on-field training

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Teamwork	Operate as a team member building relationship based on trust and cooperation in order to make the team strong and performative.	- Team dynamics. -Communication, cooperation and coordination with others. - Conflict management.	- Foster effective team communication. -Communicate efficiently with diverse teams. -Receives and offer positive and negative feedback.	Intermediate	- Theoretical training to acquire know how on team dynamics; how to efficiently work in large and international teams; - Team building; - Simulations (practice teamwork behaviours) - Case Study - Team Reviews (teams monitor the quality of their teamwork during in-situ reviews)
Situational awareness	The ability to perceive and comprehend all of the relevant information available and anticipates what could happen that may affect the operation (s: ICAO EBT)	-Factors affecting situational awareness of external factors and UA statuses. -Additionally, the RP should be able to place identify the correct location and trajectory that the UA should take to perform the desired action 3D space. -Ways of determining distances from obstacles, aircraft, clouds and populated areas. -Surveillance systems (for weather, traffic and terrain avoidance). - Aircraft general knowledge (systems, instrumentation).	-Performing solid navigations in 3D space and manage both external factors that have changed during the flight, as well as internal status of the UA (e.g., fuel, battery, link, geofence violation, inability to control payload). -The RP should also be capable of performing proper, solid and precise navigation of the UA in 3D space. -Anticipating accurately what could happen, plans and stays ahead of the situation. -Recognizing and effectively responding to indications of reduced situation awareness.	Intermediate	This skill is dependent on the capability of absorbing and paying distributed attention to several factors extrinsic and intrinsic to the UA; This skill can be acquired by training distributed attention during daily activities, as well as simulated and real flying/training.
Problem solving and Decision making	Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes (s: ICAO EBT)	-Knowledge of the existing rules and the existing procedures. -Knowledge of the possible solutions to apply in specific situations. -To know the concept of priority and urgency. -To know what the priorities in specific situations are. -To know the impact on safety that some actions may have. -To know problem-solving techniques.	-Keep still when facing disturbances: orally explain possibilities and elaborate troubleshooting process to understand abnormalities in flight and final decision making. -Review and improve past decision during debriefing. -Implements an appropriate solution to a problem. -Determines the situations that have the highest priority. -Manage risks effectively without impacting safety.	Intermediate to advanced	Theoretical Training: -Possible solutions to apply in specific situations. -Potential hazards. -How to set priorities in specific situations. -Risk Assessment process. This skill is deeply connected to the attitude and personal behaviour of the RP. Nevertheless, it can be trained by stimulating stress and forcing the RP to cope with it during simulated and real operations. This skill is also dependant on the experience of RP. Training quick assessment of possibilities, and rapid reasoning of their respective outcomes.
Workload Management	Managing available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.	-Aviation psychology (human overload and underload, fatigue and stress management, etc.). Threat and error management -Time management / planning. -Multi-tasking strategies.	-Maintaining self-control in all situations. -Planning, prioritizing and scheduling tasks effectively. -Managing time efficiently when carrying out tasks. -Offering and accepting assistance and asking for help early. -Reviewing, monitoring and cross-checking actions conscientiously. -Managing and recovering from interruptions, distractions, variations and failures effectively. -Performing all of the above for one or more aircraft with a single on-board pilot.	Intermediate to advanced	Practising parallel processing and multitasking. Practising the establishment of priorities Train on the detection of lags on the assessment of current statuses of the systems and identifying main causes of the lags/distractions.
Communications	Demonstrates effective verbal and non-verbal communications, in normal and non-normal situations.	-The importance of properly communicating to the crew and to outside receiver stations. -Types of communication. -Effective communication techniques.	-Actively listening. -Ensures the recipient is ready and able to receive the information. -Asks relevant questions. -Accurately reads and interprets required documentation and datalink messages. -Correctly interprets non-verbal communication. -Conveys messages clearly, accurately and concisely.	Intermediate to advanced	Communication styles and techniques. The Communication process. Active Listening and effective communication. Performing quick reasoning of information received and try to pose different questions to it. Practising reading of technical documentation to better get a sense of the type of language used. Practicing crew and ATC communications. Instruction of the main expressions of non-verbal communication. An important extra will be: Learning English language Performing quick reasoning of information received and try to pose different questions to it. Practising reading of technical documentation to better get a sense of the type of language used. Practicing crew and ATC communications. Instruction of the main expressions of non-verbal communication. An important extra will be: Learning English language.

Figure 15: Study Pathway for upskilling of a Professional Remote Pilot.

2.4.4.3 *Professional Remote in the Specific Category: Reskilling to fly optionally piloted aircraft / air taxis in the context of U-space operations*

This pathway will focus on the technical and behavioral competencies required to reskill a professional remote pilot in the specific category, characterized by low weight UA operations, to fly as a remote pilot and manned aircraft pilot in Optionally Piloted Aircraft and Air taxis for a UA tech company that provides both services.

The study pathway was created based on the persona of an already experienced RP in the specific category, who has considerable experience in the operation of light fixed wing aircraft. (S)He represents many professional RP who work for companies dedicated to operating uncertified UA outside the open/free operation category. Although having considerable experience in UA operation, this Persona will have to be re-skilled to fly larger, heavier UA that carry people on board.

Professional Remote in the specific category reskilling to fly optionally piloted aircraft / air taxis in the context of U-space operations		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	Air Law	- Introduction to EASA and the aviation system - Regulation (EU) 2019/945 and Regulation (EU) 2019/947 (or other Vigeant at time) - National Regulation applicable to UAS (which may differ from International) - European and International law - U-Space - Unmanned Traffic Management (UTM) - Airspaces - Insurance - Responsibilities of the UAS operators and remote pilot - ICAO Annexes and documents - Registration (Operator, Remote Pilot and Aircraft) - Licensing - Rules of the air - Procedures for air navigation services - Air traffic services and Air Traffic Management (ATM) - Aeronautical Information Services (AIS) - Aerodromes - Search and rescue - Airworthiness and permit to fly requests (international and national rules) - Automatic control towers and remote tower control - Height and altitude measurement requirements - Mandatory and voluntary reporting
	Principles of Flight	- Aircraft flight characteristics - Primary and secondary flight controls - Lift augmentation - Thrust generation - Stall - Stability (long and lateral, static and dynamic stability) - Flight limitations and envelope - Flight in adverse weather conditions - Speed of sound
	Performance	- Specific aircraft performance - Performance limitations - Stages of flight - Factors affecting performance - Takeoff, Climb, Cruise, Descent, Landing and missed approach performance (in the case of multi-engine Performance with one engine inoperative) - Propulsion controls and electronic control systems - Battery management - Flight performance with partial system failure - Overriding autopilot control - Effect of cargo and payload on performance
	Aircraft Systems	- Aircraft specific systems and subsystems - Mainframe, wings, propellers, tail, canards, control surfaces, rotary wings - Landing gear - Powerplants and accessories; powerplant limitations (RPM, blade tip speed, ice, high temperatures) - Electrics and electronics - Flight management systems - Emergency recovery systems - Parachute and lifesaving equipment - Surveillance and ATC systems: GNSS, ADS-B, SSR and Transponder, Laser altimeter, TCAS, AGCAS, CPDLC.
	UAS General Knowledge	- Manual/piloted flight controls and handling - Tele-operation flight modes - Autopilot flight modes: fly-by-wire, automatic (altitude hold, course based, waypoint based), autonomous, including artificial intelligence - Control laws and flight envelope protection - Detect and avoid subsystems - Ground control station: introduction, configurations, crew specifications, systems, subsystems, and power backups - Datalink: frequencies, jamming, limitations, power, omni-vs-direct antennas, backups, network distribution and configuration - Payloads: electro-optic visible, infra-red and stabilized cameras, radar, synthetic aperture radar, magnetometer, range finder, droppable pods, cargo, communications jamming, ELINT, COMINT - Operational limitations: speed, load, mass, balance, flight envelope, weather, engine, flight controls
	Mass and Balance	- UA configurations and their effect on stability and performance - Static margin - Max and Min cargo/payload - Take-off masses and limitations - CG location limitations - Load and Trim Sheet

	Navigation and Flight Planning	- VFR navigation - IFR navigation and procedures - Satellite based navigation, incl. augmentation systems - Detect and avoid - Flight planning - Take-off and landing planning - Contingency planning - Lateral and vertical navigation - Airspace reservation
	Weather	- Pressure systems - Types of clouds - Fronts and respective characteristics - Ice formation conditions - Forecast and report - METAR, TAF, SPECI, SIGWX - Adverse weather conditions and implications to the UA - Meteorology and limitations imposed on the flights - Low level charts - Regional weather phenomena
	Operational Procedures	- Responsibilities of the RP - U-space and UTM procedures - ATM procedures - Surrounding environment analysis, including terrain, airspace, people, buildings, electromagnetic interferences and jamming - Databases and accesses - where and how to consult the required updated information - Requirements of GCS, regarding minimal operational statues and backups - Briefing and debriefing - Checklists - Pre/post flight inspections - Flight preparation forms to be completed before flight - Overflight of uninvolved people - Procedures in case for operation near other aircraft - Manual/piloted flight and coordination with GCS RP. - GCS RP coordination with onboard pilot - BVLOS Operations; Low visibility operations; Aerodrome operating minima - Handover procedures - Emergency procedures - Duty times - Mandatory and voluntary reporting - Remote pilot logbook, maintenance records and other documentation - Notice to airmen (NOTAM) - Aeronautical Information Publication (AIP) - Emergency Response Plan (ERP) - Dangerous goods
	Communications	- U-space and UTM communication procedures - SSR and transponder codes - ATM procedures - Phraseology - Reporting - Procedures for loss of communications and data link - Distress phases and procedures - Communication with automatic control system, CPDLC and remote tower controllers - Communication between RP and Onboard Pilot
	Human Performance and Limitations	- Human sensing, equilibrium, vestibular systems - Oxygen and human limitations - Biases of remote/teleoperation when interpreting the sensors displayed in the GCS, including lags, delays and misinterpretation - Rest cycles - Workload management - Safety awareness - Threat and error management - Fit to fly self-analysis - IMSAFE assessment methodology - Limitations on perception (depth of field, distance/height to/from the UA, speed of the UA, night operations) - Disorientation - Stress, arousal and fatigue – detection and mitigation - Perception - Perception - Attentiveness - Decision-making
	Security, Privacy and data protection	- Cybersecurity and good practices - Privacy and data protection for collected contents - Common attack methods, incl. hacking, GPS spoofing, jamming - Threat detection
	Crew Resource Management / Multi-crew coordination	- Crew resource management techniques - Different types of personalities - Handling incorrectly perceived information - Tasking and commands within hierarchy of crew - Communication between onboard and remote pilots - Handling and attention to passengers - Airmanship - Leadership
	Safety, Risk assessment and management	- Safety of people onboard - Safety of people on the ground - Safety towards other aircraft - Detect and avoid - Remote pilot and crew qualifications - Probability of failure - System risk assessment - Maintenance procedures - Operational risk assessment for air and ground risk - Mitigation strategies - Presenting risk assessment to authorities for permit to fly issuance

	Main Topic	Description of content
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying...	Simulation Training	- UAV manuals - Adapting to the simulator, GCS and UA dynamics - Interaction with UAS software, firmware, and hardware - GCS cockpit layout, instruments and displays (PFD, ND, EICAS, overhead panel, central pedestal, standby instruments, radios, etc.) - Location and interpretation of commands, options and warnings on GCS - Interpretation of sensor data and operational limits of each parameter - Flight planning (pre- and during flight) - Monitoring flight parameters, incl. flight modes, path, altitude, speed, temperatures, weather, datalink, instruments, transponder and ADS-B, backups, batteries, fuel, warnings, ATC coordination, geo-fencing - Situational awareness - Very low-level operations - Decision making - Briefing and debriefing - Hand-eye coordination - Emergencies and contingency - Crew coordination, incl. two-way communication between RP and Onboard Pilot - U-space integration, procedures and new rules of the air - Perception of detect and avoid, interpreting sensors and automatic collision avoidance - Handling AI based systems and controls - ATC and automatic control practices - Changing ATC jurisdiction and type of airspace - Cyber- and data-link security, data protection
	Real-flight training on basic UA (if final UA is heavier or much more complex)	- UA manuals, UA status, logbook, anomalies - Operation of GCS Hardware and Software - Aircraft performance and limitations - Crew management and coordination (with external pilot, take-off technician) - Interpretation of sensor data and operational limits of each parameter - Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) - Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications - Monitoring of the aircraft's systems (fuel, electrics, etc.) based on GCS data and pilot communications - Standard Operating Procedures (SOPs) - Briefing and debriefing - Flight procedures (before start, start, taxi, before take-off, taxi, (rejected) take-off, climb, operations, descent, approach, missed approach, landing, after landing, taxi and parking) - Adapting flight to weather, ATC, operational limitations and other contingencies - Situational awareness - Very low-level operations - Communicating with other crew (e.g., payload operator, mission director) sharing and coordinating information - Crew coordination, incl. two-way communication between RP and Onboard Pilot
		- Decision making - Hand-eye coordination - Emergencies and contingency - U-space integration, procedures and new rules of the air - Perception of sense and avoid, interpreting sensors and automatic collision avoidance - ATC and automatic control practices - Changing ATC jurisdiction and type of airspace - UA control handover to another RP in the same GCS - UA handover to another GCS - Cyber- and data-link security, data protection

COMPETENCES (select 3 to 5 to each group)					
Technical Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce					
Competence	**Competence Description**	**Knowledge**	**Skill**	**Level**	**Preliminary Training Topics**
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Operation of UA and flight path control and management, manual/fly-by-wire	Coordination of necessary in-flight manoeuvres with intended manual commands. Coordination of the flight path, maintaining proper guidance, and appropriate distance to obstacles, aircraft, terrain and people, while interpreting the sensors and indicators.	-Typical UA dynamics in 3D space. -Aircraft control, piloting. -Cockpit hardware, layout, functions and software. -Control and telemetry link between the GCS and the aircraft. -How to conceptually avoid entering limited zones and avoiding conflict and risky situations by properly controlling the UA to avoid the areas (divert/heading change, climb, (de)increase airspeed.	-Flying an aircraft within its limits -Operating onboard systems correctly, independently and efficiently -Using the correct commands and inputs depending on the phase of the flight -Performing proper, steady, coordinated flights and operations at all times.	Advanced	-Understanding of the UA flight performance, capabilities and limitations. -Familiarization with cockpit and UA. -Training and practising all allowed flight modes. -Practical (both simulated and real) flights in various weather conditions within the limitations of the UA. -Operation in abnormal conditions.
Operation of GCS, UA flight path control and management, automation	Coordination of necessary in-flight manoeuvres with intended commands and automation processes. Coordination of the flight path, maintaining proper guidance, and appropriate distance to obstacles, aircraft, terrain and people, while interpreting the GCS sensors and indicators.	-GCS hardware and software. -Communication link between the GCS, the aircraft and ATC. -Control and telemetry link between the GCS and the aircraft. -Typical UA dynamics in 3D space. -Types of automation typically present in a UA (tele-operation with stick and pedals, handset operation, remote fly-by-wire, automatic waypoint-based navigation, course navigation altitude hold, position hold. -How to conceptually avoid entering limited zones and avoiding conflict and risky situations by properly controlling the UA to avoid the areas (divert/heading change, climb, (de)increase airspeed.	-Operating GCS tools correctly, independently and efficiently. -Using the right ground control station tools depending on the phase of flight. -The individual should be able to accurately fly the UA in BVLOS and FPV (video - first person view) operations. Capable of coordinating his intentions with correct UA control. -Performing proper, steady, coordinated flights and operations, by selecting the proper flight mode and command at all times. -Interpreting and coping with AI flight modes in a correct manner.	Advanced	-Understanding of the UA flight performance, capabilities and limitations. -Familiarization with GCS/cockpit and UA flight modes. -Training and practising all allowed flight modes. -Practical (both simulated and real) flights in various weather conditions within the limitations of the UA; Operation in abnormal conditions.

Application of Procedures	Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge (Source: EBT ICAO).	-The importance of understanding and following procedures. -The importance of regulations and rules of the air. -The consequences of not following or understanding the procedures.	-Understanding the rules and restrictions applicable to the operation of the UA, in different locations and scenarios. -Collect and assess proper information about current and future status of the UA, airspace limitations and segregation. -Fulfil all requirements in terms of licences and requests necessary for the operations.	Advanced	-Studying and learning from the theoretical course; applying the theoretical knowledge to the location/scenario of the operation; -Being informed by the instructors about the reasoning behind the procedures and the consequences of not following them in terms of safety and security;
Assessment of operational scenario	Capable of assessing the operational scenario of the operations, prior to and during the flight. Capable of interpreting the current and future status of the operational scenario based on flight planning, briefing information and current observations. Capable of adjusting flight path and control over the UA to perceived changing conditions.	-The importance of performing scrutinous data collections (briefing, weather, flight planning, and contingencies) prior to the flight. -The importance of being alert to the external factors affecting an operational scenario, and interpreting the information provided from the UA, in light of the pre-flight briefing data.	-The remote pilot should be able to properly identify the limiting factors of the foreseen scenario of operation, including: overflight of people, buildings, airspace limitations, weather, take-off and landing zones, contingency zones (MEUH). -To understand wind, clouds in the sky, their type and movement, water, infer uses for different zones in the scenario, including buildings, people actions and movement.	Advanced	-Studying and learning from the theoretical course; attention to detail and all aspects comprising a given scenario; -Comparing the influence of a misinterpretation of the pre-flight information bulletin/briefing; -Practical training, in normal and simulated abnormal conditions;
Risk assessment and safety-based judgement	The ability to identify and rank risks, to determine which are critical and above the risk tolerance or threshold and thus require attention, and then to select the risk management action(s) to take in response.	Risk assessment of the operational scenario, limiting factors and status of the UA.	Establish hierarchies of priorities according to the mission and MEUH, define "go_/_no go" and "return-to-home" conditions, forbidden areas or actions based on MEUH.	Advanced	-This skill is highly dependent on the knowledge and attitude of the remote pilot; it will depend on intrinsic factors, like the boldness of the RP to take risks and to consider risks with low probability of occurring as being risk that should be acknowledged and mitigated. -The trainees should be aware of the safety behaviours and trained of how they can follow them on the field. -Training should have a practical component with case studies from real pilot situations and even with on-field training.

Behavioral Skills: Considering the competences identified on the Persona, please fill in the theoretical and practical knowledge that the correct acquirement of the skill should induce

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	***Short competence description***	***The individual should have knowledge of...***	***With this skill someone should be capable of....***	***Beginner Intermediate Advanced***	***How to acquire the skill?***
Situational awareness	The ability to perceive and comprehend all of the relevant information available and anticipates what could happen that may affect the operation (s: ICAO EBT).	-Factors affecting situational awareness of external factors and UA statuses. -Additionally, the RP should be able to place identify the correct location and trajectory that the UA should take to perform the desired action 3D space. -Ways of determining distances from obstacles, aircraft, clouds and populated areas. -Surveillance systems (for weather, traffic and terrain avoidance). -Aircraft general knowledge (systems, instrumentation).	-Performing solid navigations in 3D space and manage both external factors that have changed during the flight, as well as internal status of the UA (e.g., fuel, battery, link, geofence violation, inability to control payload). -The RP should also be capable of performing proper, solid and precise navigation of the UA in 3D space. -Anticipating accurately what could happen, plans and stays ahead of the situation. -Recognizing and effectively responding to indications of reduced situation awareness.	Intermediate	-This skill is dependent on the capability of absorbing and paying distributed attention to several factors extrinsic and intrinsic to the UA. -This skill can be acquired by training distributed attention during daily activities, as well as simulated and real flying/training.
Analytical Capability	Ability to collect and analyse information, problem-solve, and make decisions.	Basic forms of processing information and channelling it to perform sensemaking and logic-related tasks.	-Properly managing and prioritizing the several the stimuli received. -The RP should be capable of processing information from different sources in well organized, priority- based management strategy. -This information can be provided to all five senses of the RP.	Advanced	-Theoretical Training. -How to process information. -Techniques to analyse information: written and visual. -This skill can be trained in classroom where we can assess the individual's level and present different techniques to analyze information. The simulation will be the practical exercise, where information with different priorities is provided via stimuli to all five senses.
Problem solving and Decision making	risks and resolves problems. Uses the appropriate decision-making processes (s: ICAO EBT)	and the existing procedures. -Knowledge of the possible solutions to apply in specific situations. -To know the concept of priority and urgency. -To know what the priorities in specific situations are. -To know the impact on safety that some actions may have. -To know problem-solving techniques.	possibilities and elaborate troubleshooting process to understand abnormalities in flight and final decision making. -Review and improve past decision during debriefing. -Implements an appropriate solution to a problem. -Determines the situations that have the highest priority.		-This skill is deeply connected to the attitude and personal behaviour of the RP. -Nevertheless, it can be trained by stimulating stress and forcing the RP to cope with it during simulated and real operations. This skill is also dependant on the experience of RP. -Training quick assessment of possibilities, and rapid reasoning of their respective outcomes.
Workload Management	Managing available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.	-Aviation psychology (human overload and underload, fatigue and stress management, etc.). -Threat and error management. -Time management / planning. -Multi-tasking strategies.	-Maintaining self-control in all situations. -Planning, prioritizing and scheduling tasks effectively. -Managing time efficiently when carrying out tasks. -Offering and accepting assistance and asking for help early. -Reviewing, monitoring and cross-checking actions conscientiously. -Managing a recovering from interruptions, distractions, variations and failures effectively. -Performing all of the above for one or more aircraft with a single on-board pilot.	Advanced	-Practising parallel processing and multitasking. -Practising the establishment of priorities. - Train on the detection of lags on the assessment of current statuses of the systems and identifying main causes of the lags/distractions.
Communications	Demonstrates effective verbal and non-verbal communications, in normal and non-normal situations.	-The importance of properly communicating to the crew and to outside receiver stations. -Types of communication. -Effective communication techniques.	-Actively listening. -Ensures the recipient is ready and able to receive the information. -Asks relevant questions. -Accurately reads and interprets required documentation and datalink messages. -Correctly interprets non-verbal communication. -Conveys messages clearly, accurately and concisely. -Crew resource Management.	Advanced	-Communication styles and techniques. -The Communication process. -Active Listening and effective communication. -Performing quick reasoning of information received and try to pose different questions to it. -Practising reading of technical documentation to better get a sense of the type of language used. -Practicing crew and ATC communications. Instruction of the main expressions of non-verbal communication. -An important extra will be: Learning English language.

Figure 16: Study Pathway for reskilling of a Professional Remote Pilot.

3 Next Steps

The Skill-UP Study Pathways will be used to feed the next tasks of the project. Specifically, the training programs (WP3) and the VET training assessment portfolio (WP4). Following the process for other Skill-UP results, the study pathways will be integrated in the Knowledge Center (WP5), an e-learning platform that Skill-UP will develop into the next phase of the project.

To achieve this, the Study Pathways will be graphically implemented, in compliance with the graphical representations of the Personas and of future aviation scenarios. The Skill-UP Study Pathways graphic version will be presented as a path, highlighted the main topics and competencies defined in each professional profile.

Furthermore, the Skill-UP Study Pathways will be validated to an external specialist from the four distinct future scenarios, this represents an important step in the process of selecting the greatest information to incorporate in the graphical version.

4 References

[1] International Civil Aviation Organization (2013). Manual of Evidence-based Training. ICAO.

[2] Skill-UP Project (2020). D2.1 From Theory to Practice. Understanding user profiles and training needs. Co-funded by the Erasmus+ Programme of the European Union. Consulted on: https://www.skillup-air.eu

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