SKILLING, UPSKILLING, RESKILLING

IN THE FUTURE AIR TRANSPORT

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D2.1 From theory to practice

Understanding user profiles and training needs

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SKILLING, UPSKILLING, RESKILLING IN THE FUTURE AIR TRANSPORT

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List of Acronyms

Acronyms List	
AI	Artificial Intelligence
ANSP	Air Navigation Service Provider
ARFF	Aircraft Rescue and Fire Fighting
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
BVLOS	Beyond Visual Line of Sight
CEO	Chief Executive Officer
CPDLC	Controller-Pilot Data Link Communications
CRM	Crew Resource Management
CTKI	Chief Theoretical Knowledge Instructor
CTR	Control Zone
DCS	Departure control system
DGR	Dangerous goods regulation
EBT	Evidence Based Training
EQ	Emotional Intelligence (or Emotional Quotient)
EU	European Union
HMI	Human Machine Interface
HPL	Human Performance & Limitations
ICT	Information and communications technology

IFR	Instrument Flight Rules
IMS	Integrated management system
IQ	Intelligence Quotient
ISR	Intelligence Surveillance Reconnaissance
IT	Information Technology
MCC	Multi Crew Co-Operation
OJTI	On the Job Training Instructor
OPV	Optionally Piloted Vehicle
PM	Pilot Monitoring
PPL	Private Pilot License
PRM	Passenger reduced mobility
RC	Radio Controlled
RNP	Required Navigation Performance
RPAS	Remotely Piloted Aircraft System
SAP	Accounting-Finance-Customer Relation ERP software
SatCom	Satellite Communications
SOP	Standard Operating Procedures
SPO	Single Pilot Operations
STEM	Science, Technology, Engineering and Maths
TRE	Type Rating Examiner
TRI	Type Rating Instructor
UAS	Unmanned Aircraft System

UPRT	Upset Prevention and Recovery Training
UTM	Unmanned Traffic Management
VET	Vocational Education and Training
VLL	Very Low Level
VLOS	Visual Line Of Sight

Executive summary

The main purpose of this document is to present the results and conclusions of two tasks within the skill-UP project, namely;

- Task 2.1 - *Individual differences*
- Task 2.2 - *Personas: Development of future competency profiles*

The aim of Task 2.1 was to gain an understanding of how theoretical and practical knowledge acquired through education and training prior to employment is later applied in the workplace. For this purpose, a survey and interviews were designed and administered so as to explore the following aspects:

- The **facilitators and barriers** associated with adaptation to work settings following a period of study;
- Any **misalignments between educational and labour** skill requirements;
- The **impact of individual differences** on employees' adaptation to new scenarios;
- Any **risks and opportunities** associated with implementation of new organisational practices and innovative technologies.

The key conclusions are as follows:

- Several gaps and issues exist in training, and some of these issues are common across multiple categories of VET users.
- Several gaps and challenges exist in the workplace. Some of these gaps and challenges arise from training deficiencies, while others are due to the initial lack of experience of the employee or the unique characteristics of each workplace environment.
- Technology is one of the key drivers of change. Changes will be disruptive in the case of UAS operations while, for other VET users, changes will be incremental.
- Regulation will also have to change. Such changes will partly be necessitated by new technology; however, regulatory changes will still lag behind technological advancements.
- Some jobs will be replaced by automation. However, new jobs will also be created as a by-product of such new technology. This will necessitate the re-skilling and up-skilling of certain job profiles.
- Roles which require human interaction and coordination are less likely to be affected by new technology.
- Some of the most in-demand skills in the future will be adaptability, IT and technology-related skills.

The aim of Task 2.2 was to develop Personas, namely the target users of the future aviation VET training programmes. In line with this, the Skill-UP Personas were developed to visualise future aviation job profiles. Twelve Personas were designed with the purpose of describing the competences (knowledge, skills and attitudes) needed to undertake the essential tasks in the future operational scenarios and related training needs. The following job profiles were selected:

- Remote tower ATCO and On the Job Training Instructor (OJTI) for the ATC domain
- Single Pilot and Ground Pilot for the Commercial Aviation domain
- Remote pilot for the RPAS domain
- Check-in agent for the airport environment

The Personas will be used to feed the next tasks of the project.

In fact, since they include a section on expected competences, they will support the development of the Air Sector Skills Transformation Map (Task 1.4), which will work as a tool to visualize the gaps between current and future competences needed by the aviation workforce.

The Skill-UP Personas will be also used to feed the development of the study pathways (Task 2.3), and, based on them, also of the training programmes (in WP3) and the VET training assessment portfolio (in WP4).

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

To achieve this, Personas will be graphically implemented, in compliance with the graphical representations of future aviation scenarios.

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 programmes 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 programmes 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 VET users and target groups

This document makes several references to the terms 'VET users' and 'target groups'. In the context of skill-UP:

- 'VET users' refers to flight crew, air traffic control, airport operations and UAS operations;
- 'Target groups' refers to employees (new entrants, professionals and practitioners), employers and external training providers.

1.3 Purpose and scope of the document

The main purpose of this document is to present the results and conclusions of two tasks within the skill-UP project, namely;

- Task 2.1 - *Individual differences*
- Task 2.2 - *Personas: Development of future competency profiles*

The challenge to address the gaps within the required skills and knowledge, gaps which may be amplified by the advancements mentioned in Section 1.1, requires a collaborative effort between the industry and educational institutions. First and foremost, the school-to-work transition needs to be addressed, in order to better prepare the future workforce for the evolving working environment. Task 2.1 seeks to present an understanding of how theoretical and practical knowledge acquired through education and training is eventually applied in the workplace. This is presented for all VET users as described in Section 1.2. Issues associated with pre-employment education and training are investigated such that existing gaps and challenges can be identified. The task also looks into the challenges which the different VET users face when adapting to a new working environment following an educational or training programme. Therefore, misalignments between educational, training, and labour skill requirements are identified.

Task 2.2 seeks to present future competency profiles for the different VET users in the form of Personas, based on results and conclusions derived from WP1 of the skill-UP project and Task 2.1 itself. The aim of the Personas is to present a visualised representation of the future job profiles and the associated specific user profiles. They attempt to describe the training needs, skills, and competency levels required by individual user profiles in order to be able to perform the required tasks in the foreseen future scenarios.

This document does not look in detail at these future scenarios as these are further explained in another deliverable of the skill-UP project; *D1.1 Skills, needs and future work scenarios: Air Sector Skills Transformation Map*. However, these future scenarios are mentioned in the context of being one of the inputs for Task 2.2 and the development of the Personas mentioned above.

Also, this document does not delve into possible study pathways for the skilling, upskilling or reskilling of the future workforce since this will be described in another deliverable; *D2.2 Study pathways: Skilling, Upskilling and Reskilling*. In fact, results and conclusions derived from both Tasks 2.1 and 2.2, as described in this document, will eventually serve as inputs for Task 2.3, the outputs of which will be described in D2.2.

1.4 Deliverable structure

This document is divided into four parts.

Section 1 - *Overview* - gives a brief overview of the Skill-UP Project and defines the VET users and target groups which are referred to in the following sections.

Section 2 - *Individual Differences* - describes Task 2.1 of the Skill-UP Project and its aim in addressing how theoretical and practical knowledge acquired through education and training is later applied in the workplace. The section describes the use of an online survey and structured interviews to gather data and the subsequent analysis. The results and conclusions derived from the survey and interviews are explained in detail in this section.

Section 3 - Personas: Development of future competency profiles - describes Task 2.2 of the Skill-UP Project which aims to assist employers, employees and training providers to visualise future competency profiles in new scenarios identified and selected in WP1. The section describes a series of personas representing these future competency profiles, with each persona describing the training needs identified through Task 2.1 and the skills and level of competence identified in WP1 which are required to perform the essential tasks in the selected scenarios.

Section 4 - *Next steps* – describes how the Personas developed through Task 2.2 (as described in Section 3) will be used to feed the next steps of the project, namely the design of different study pathways, the VET training programmes and assessment portfolios and their integration in the Knowledge Center.

2 Individual Differences

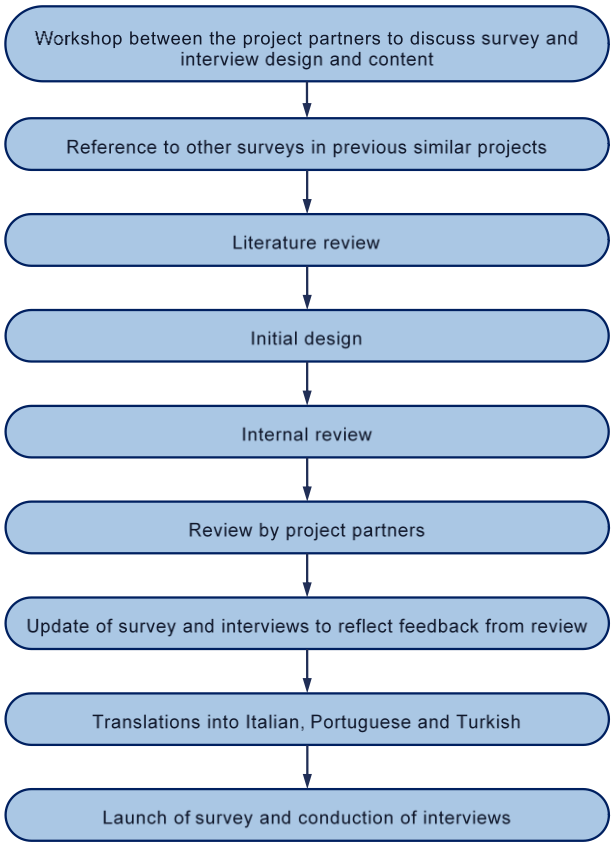
2.1 Task scope & objectives

The aim of Task 2.1 was to gain an understanding of how theoretical and practical knowledge acquired through education and training prior to employment is later applied in the workplace. For this purpose, data from the different target groups and VET users (defined in Section 1.2) was acquired so as to explore the following aspects:

- The **facilitators and barriers** associated with adaptation to work settings following a period of study;
- Any **misalignments between educational and labour** skill requirements;
- The **impact of individual differences** on employees' adaptation to new scenarios;
- Any **risks and opportunities** associated with implementation of new organisational practices and innovative technologies.

2.2 Methodology

Data was gathered through a survey and through structured interviews, combining a mixed method approach eliciting both qualitative and quantitative data[1]. The process adopted in the development of the survey and interviews is shown in Figure 1. In order to allow for the participation of a wider range



[1] Bickman, L., & Rog, D. J. (2009). The SAGE handbook of applied social research methods. Thousand Oaks, CA: SAGE Publications

of nationalities, the survey – originally set up in English – was translated into Italian, Portuguese and Turkish. Similarly, the interviews were conducted in these four languages as well.

Figure 1 - Development process of survey and interviews

2.2.1 Survey

An online platform (Google Forms) was used for the survey, allowing for the widest exposure possible. Links to the survey were sent to several stakeholders within the industry, including airlines and other companies involved in commercial air operations, Air Navigation Service Providers (ANSPs), airport handling and service providers, flight training organisations, drone operators and aviation employees' associations. These stakeholders were asked to promote the survey internally within their respective organisations. Furthermore, the survey was also promoted through various social media channels. The survey was open for approximately six weeks. The responses of the non-English surveys were translated to English and the survey data was then gathered and analysed.

The survey consisted mostly of Likert scale rating questions. However, open-ended questions were also asked. Thus, the survey produced both quantitative and qualitative data. The first section of the survey was related to the participants' background and was common for all participants. The second section was tailored to each target group. Thus, depending on which target group the participant identified himself/herself with in the first section, the appropriate second section for that target group was presented accordingly. The English version of the survey can be found in Appendix I.

2.2.2 Interviews

Structured interviews were conducted with participants from the three different target groups, i.e. employers, employees and training providers, with a different set of questions asked to each target group. Participants within each target group were selected in such a way that the four different groups of VET users were duly represented. As with the survey, interviews were conducted in different languages. Prior to the analysis, all responses were first translated to English.

The interview questions were mostly open-ended and therefore the responses produced mostly qualitative data. Closed-ended questions, using rating scales, were also used resulting in some quantitative data which was eventually added to the data from the survey responses. The English version of the interview questions can be found in Appendix II.

2.3 Overview of participants

A total of 163 respondents participated in the survey, whilst a total of 41 interviews were conducted.

2.3.1 Demographic data

The nationality and age of the survey and interview participants are shown in Figure 2 and Figure 3 respectively. As can be observed, 79% of the participants were in their 30s, 40s and 50s which suggests that, probably, most of the participants were fairly experienced in their respective role. The gender distribution of survey participants was 74% males, 25% females and 1% other.

2.3.2 Roles of VET users

As explained in Section 1.2, skill-UP is targeting four different categories of VET users across three target groups. The survey respondents and interview participants where thus categorised according to these criteria as shown in Table 1 and Figure 4.

As expected, the vast majority of participants were classified as employees whilst the number of employers and training providers was relatively low. The highest number of VET users were flight crew, followed closely by air traffic controllers. Participants who could not be classified under any of the VET user categories were classified as Other.

The specific roles of the survey and interview participants are shown in Table 2. It can be observed that these roles include front line operational, training, supervisory, managerial and executive roles. The roles identified under *Flight crew* include both civil and military roles.

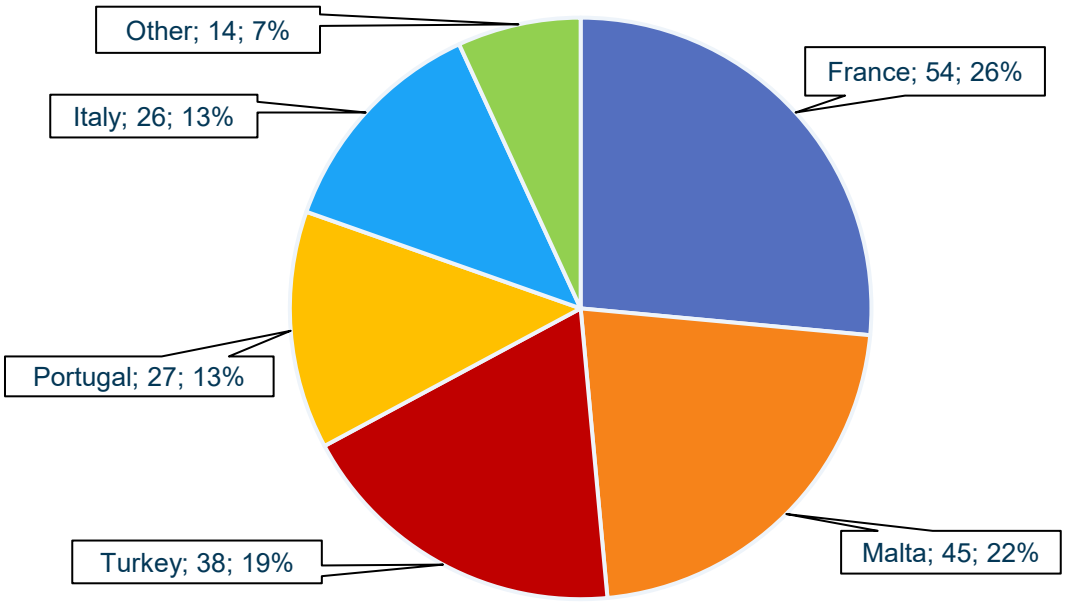


Figure 2 - Nationality of participants

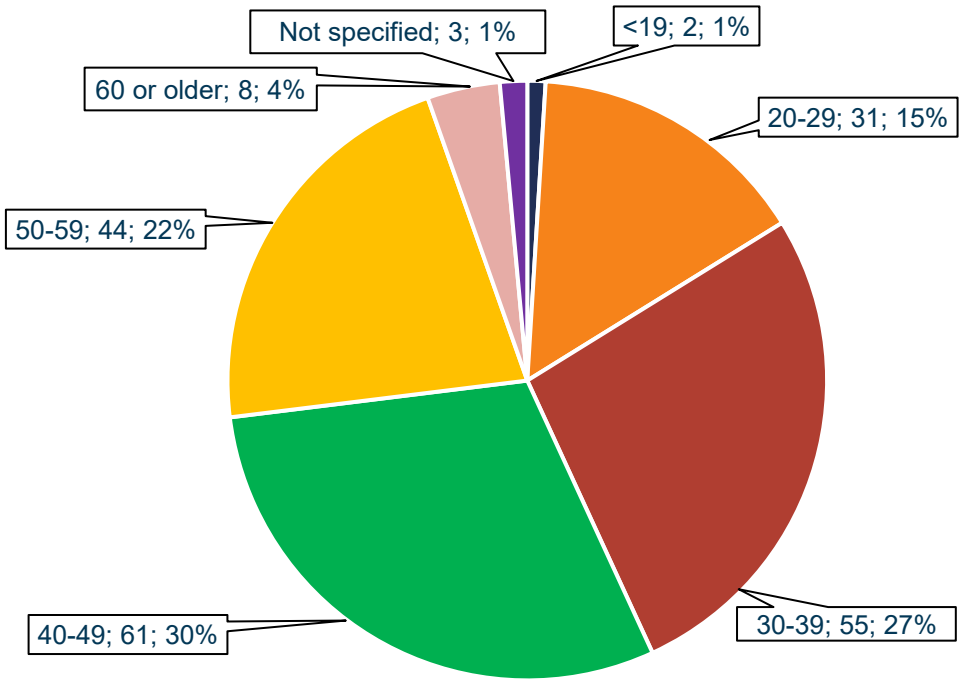


Figure 3 - Age of Participants

Table 1 - Participants by VET users and target groups

Roles	Employee	Employer	External training provider	Total
Flight crew	66	3	4	73
Air Traffic Control	57	4	5	66
Airport operations	25	2	2	29
UAS operations	9	2	4	15
Other	12	0	9	21
Total	**169**	**11**	**24**	**204**

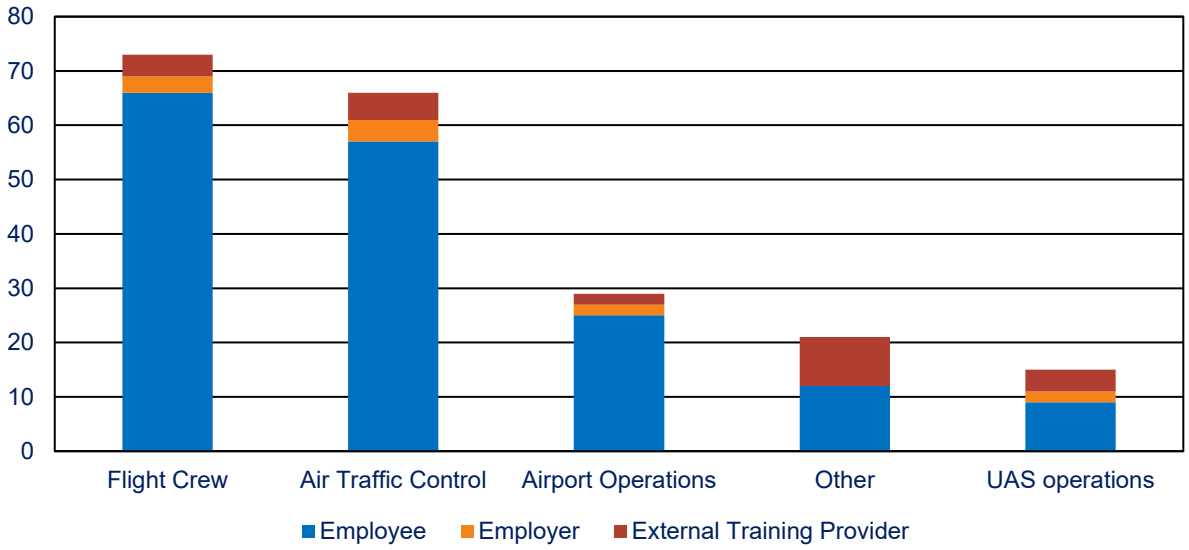


Figure 4 - Participants by VET users and target groups

Table 2 - Roles of the survey and interview participants

VET Users	Identified roles
Flight crew	First officer, Captain, Flight Instructor, Flight Examiner, Type Rating Instructor/Examiner (TRI/TRE), Chief Pilot, Deputy Chief Pilot, Head of Training, Chief Theoretical Knowledge Instructor (CTKI), Safety Manager, Quality Manager
Air Traffic Control	Air Traffic Controller Officer (ATCO) (across different strata, i.e. ground tower, approach, area, etc.), Instructor, Watch Supervisor, Programme Manager, Training and Development Specialist, Head of Competence, ATM Event Investigator, Student
Airport operations	Check-in Agent, Chief Officer Operations, Head Passenger Services, Passenger Handling Supervisor, Safety Data Analyst, Ground Handling Agent, HR Manager, Terminal Manager, Airport Rescue and Firefighting Officer, Cargo Export Officer

UAS operations	Drone Operator, Remotely Piloted Aircraft System (RPAS) instructor, Safety Test Engineer, Technician, Manager, Chief Executive Officer
Other	Airworthiness, Product Owner, Lecturer/Academic, Training Manager, Safety and Human Factors Expert, Aircraft Maintenance Technician

2.4 Pre-employment Training

Prior to employment, VET users generally undergo some form of training that prepares them for that subsequent employment. This training is different from any initial training which new employees may receive upon joining a new company and is normally done by an external training provider. Nevertheless, some companies have their own (in-house) training setups and can also offer such training themselves, normally in the form of sponsored cadetships. This section analyses such pre-employment training and begins by highlighting the differences between the different categories of VET users. The quality of training as perceived by the different users is then explored and the relationship between training providers and employers is discussed. Finally, current training gaps and issues are identified for each VET user category.

2.4.1 Differences between VET users

A significant difference (between VET users), which can be observed from the survey responses shown in Figure 5, is related to whether the participants followed pre-employment training in the first place. Whilst the majority of flight crew and air traffic controllers (95% and 70% respectively) claimed to have followed a training programme prior to their employment, only 52% of respondents involved in airport operations and 50% of respondents involved in UAS operations claimed that they did. This considerable difference can be explained by the fact that training requirements for flight crew and air traffic controllers are highly regulated and far more structured, whereas this is not necessarily the case for airport and UAS operations. For flight crew and air traffic controllers, the job requires a licence which is only obtained after completing a formal training programme which is dictated by regulations. Such training normally takes 1.5 to 2 years to complete. On the other hand, the majority of new airport employees are given initial on-the-job training, without having been formally trained beforehand. In the case of UAS operations, training is neither well regulated, nor is it harmonised between different countries. This may therefore give rise to possible gaps in training requirements and may explain why only half of the participants in this VET user category followed pre-employment training.

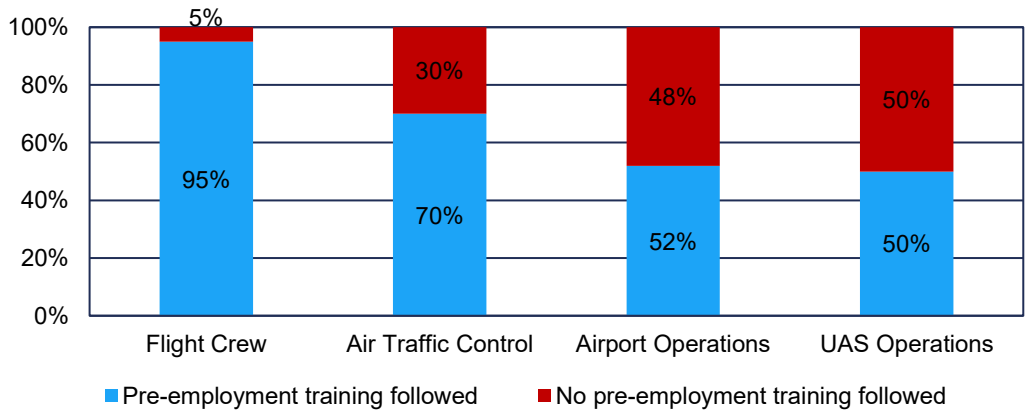


Figure 5 - Pre-employment training

From Figure 4 it can also be observed that 30% of air traffic controllers (and a small percentage of flight crew, 5%) still claimed that they did not follow any training prior to employment. This is rather contradictory since, as stated above, both air traffic controllers and pilots require a licence to operate.

As stated earlier on, whilst such training is often done with an external training provider before an employee formally starts employment, in certain cases this training may be followed through a cadetship with the employer itself. This may explain why some of the flight crew and air traffic controllers stated that they did not follow any pre-employment training when, in fact, they would have.

2.4.2 Quality of training

The survey respondents were asked to rate the quality of the training which they received prior to employment with respect to several key indicators. The results are shown in Figure 6. When considering all VET users, *knowledge and experience of the instructors* was rated highest, followed by *delivery of training sessions* and *relationship between the trainer and trainees*. *Exposure to the workplace* scored the lowest, suggesting that this could be one of the improvements which can be made in such pre-employment training.

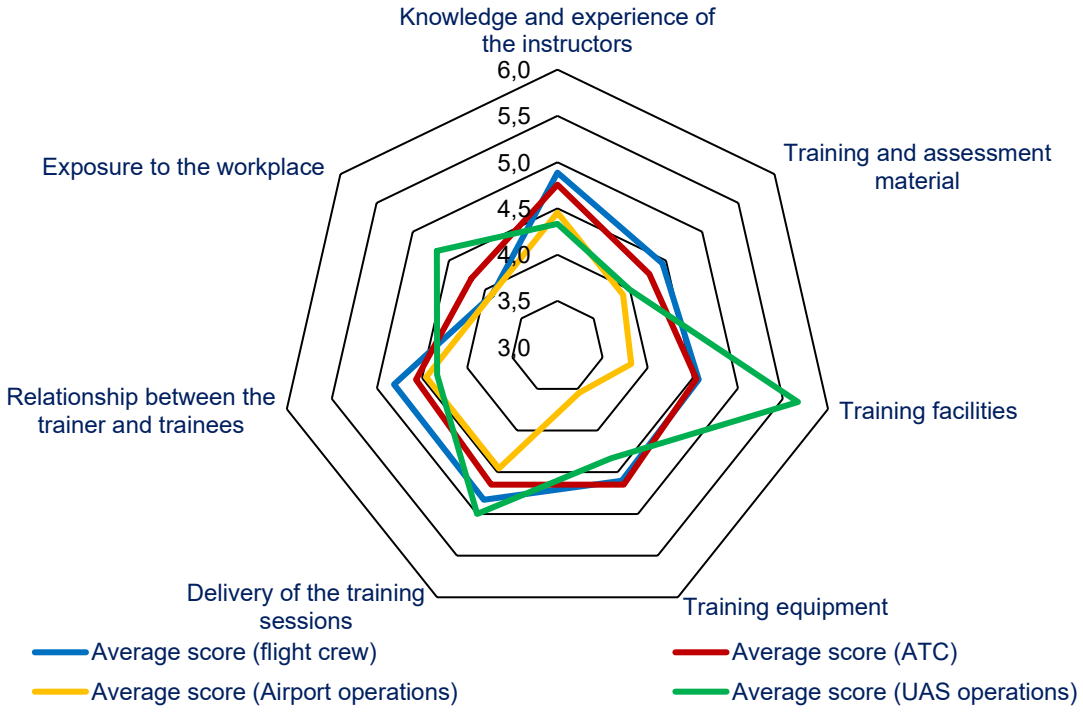


Figure 6 - Quality of training

2.4.3 The relationship between employers and training providers

The type of relationship between employers and training providers was found to vary from one external training provider to another. Some training providers are totally independent of any employers whereas others collaborate with employers and are tasked with offering specific training for future employee candidates of those employers. Such collaboration allows the training providers to tailor their training programmes and make them more specific to the training needs of a particular employer. Some employers actually work directly with a selected training provider and set up the appropriate training syllabi together with the training provider. Collaboration ranges from frequent communication and feedback exchange between the employer and the training provider, to subject matter experts from the employer working directly with the training provider.

Nevertheless, the relationship is not necessarily always entirely positive, and some training providers feel that, at times, certain employers are too intrusive and controlling. Other training providers

mentioned the issue of lack of trust between the two and some employers complained that adequate and timely feedback is not always received.

Some employers also have their own training centres set up. Thus, external training providers are only engaged if and when certain training requirements cannot be met in-house or when the employer's own training capacity is exceeded.

2.4.4 Identified gaps/issues in current initial training

The survey respondents and interview participants were asked to identify gaps and issues which they feel are present in the initial pre-employment training phase described above. The following is a detailed analysis of these gaps and issues as identified by the different VET users across each of the target groups.

2.4.4.1 Flight crew

Gaps and issues identified by employees

An issue which was widely mentioned by flight crew is the limited training in human factors. They argued that human factors training should feature more, and at every stage of the training. People skills, including attitude, composure, etc., should be thoroughly trained and assessed. Keeping in mind that most pilots will end up working in commercial air transport (the majority of which would deal with the carriage of passengers), some also suggested that passenger interaction should also feature in the initial training.

Another gap which was identified was the fact that almost all the training and evaluation is mainly focused on single-pilot skills. This gap should be viewed in the context that most of the newly licenced pilots will end up working in a multi-pilot environment. Whilst a specific training programme – the Multi Crew Co-Operation (MCC) course – is required prior to transitioning to such a working environment, this course is only introduced at the tail-end of the initial training. The important role of *Pilot Monitoring* (PM) should be introduced earlier, especially since it is widely accepted that the lack of adequate monitoring is a major contributory factor in most accidents.[2]

Many pilots also argued that the time spent in a simulator is limited. This means that abnormal scenario training may be limited. Furthermore, certain abnormal scenario training is repetitive and predictable. The latter may contribute to pilots not being adequately trained in managing the startle effect which a sudden and unexpected event would trigger.

Another issue which was mentioned was that basic flying skills need to be given more importance especially at the very beginning of a pilot's journey, with some arguing that increasing the amount of minimum training hours may help with this. The focus on airmanship and decision-making skills also needs to be increased.

For flight instructors, some pointed to the fact that all the training to acquire a flight instructor rating is done with another flight instructor and proposed that some of that training should be performed with real students, under the supervision of another instructor. Pilots also commented on the fact that the majority of flight instructors often do not have prior experience in the industry, something which would definitely be desirable.

[2] Flight Safety Foundation – 'A Practical Guide for Improving Flight Path Monitoring' – November 2014.

Flight crew also commented on the fact that the current training regime is somewhat outdated, especially when considering the fast pace at which technology has advanced. Training lags behind such technological advancements and thus requires some catching up.

A gap which was also mentioned and agrees with the results discussed in section 2.4.2 is the lack of exposure to the workplace. Security concerns, especially in the post September 11th events era and associated restrictions, may pose a difficulty in addressing this gap. Nevertheless, some training organisations, in close collaboration with airline operators and with the appropriate security protocols in place, do offer workplace exposure schemes in the form of observation flights.

Gaps and issues identified by training providers

Training providers commented on the fact that a balance between theoretical knowledge and practical skills needs to be found. Currently, the theoretical part is too vast and, as an airline pilot, most of that theoretical knowledge may not necessarily prove to be useful on the job. Thus, more practical work is needed. In addition, the theoretical knowledge is too generic.

Training providers also seemed to point fingers at the regulations, which were described as too prescriptive. They suggest that training organisations should be allowed the flexibility to adjust their training programmes as required to cater for particular needs of their trainees. Furthermore, this prescriptiveness may also be restricting the amount of time dedicated to skills such as teamwork, even though such training is often not appreciated sufficiently by trainees. Training providers also argued that there is a misalignment between the regulatory bodies and the industry itself. Regulations need to be updated so that training can focus more on certain areas which are deemed as being more essential, e.g. Upset Prevention and Recovery Training (UPRT). Training providers also commented that basic instrument flying skills are getting weaker and training may require a review in that respect.

Finally, for airline companies, training providers commented on the fact that, whilst newly licensed pilot may join a company with the required flying skills, they lack a fundamental understanding of how an airline works. Again, this suggests that increasing the exposure to the workplace during the initial training may prove to be beneficial.

Gaps and issues identified by employers

Similar to training providers, employers commented that most of the gaps in the initial training are a consequence of regulations. They highlighted the fact that training is regulated by outdated rules which require a thorough review to bring them in line with today's requirements. As an example, employers mentioned the regulatory requirement to train for engine failure scenarios during takeoff. Such a scenario is possible and thus needs to be trained for. However, the reliability associated with aircraft engines today is so high that such a scenario is highly unlikely. Thus, employers argued that regulations need to be adapted such that training will target areas which have ultimately been proven to be contributory factors in major accidents. They cited the loss of Air France 447 as an example, which eventually led to UPRT being mandated.

Employers commented that, nowadays, training is shifting towards Evidence-Based Training (EBT). This should aid in closing the gaps described in this section.

2.4.4.2 Air traffic control

Gaps and issues identified by employees

Similar to flight crew, one of the issues identified by air traffic controllers is human factors training. This needs to be given more importance, particularly stress and workload management. Air traffic control is a stressful job and future controllers must be trained to adequately manage any situation and its associated workload.

Air traffic controllers also mentioned the fact that training programmes are often too prescriptive and somewhat repetitive. Training should focus more on problem solving, in which the trainee is given a situation to which he/she has to build up a solution based on his/her own analysis of the situation, rather than being taught a 'recipe' for a solution.

The need to strike a proper balance between theory and practice was also mentioned. Some argued that there is too much focus on theoretical knowledge, some of which is also not necessarily related to the core job of air traffic control and management. The theoretical and practical aspects seem to be disconnected and more is required to bridge the gap between the two. Many suggested that training should shift more towards the practical aspect, with more time being assigned to simulator training. Scenarios practiced during simulator training should also be more realistic and address issues such as multi-tasking, handover techniques between ATCOs, and teamwork and collaboration between different sectors. Training should also be driven by the constant advances in technology.

On the quality of training personnel, it was pointed out that instructors should mostly be ATC practitioners themselves. At times, training centres are staffed with instructors who are permanently giving instruction and may therefore lose touch with the realities of the job.

Air traffic controllers, like flight crew, argued that exposure to the job is lacking during initial training and some suggested that training programmes should include a period of internship, so that future ATCOs are immediately exposed to the realities of the job.

Gaps and issues identified by training providers

Training providers commented on the fact that initial training is often too generic. It is understandable that further training would be required once a new ATCO is assigned to a particular centre or sector. However, the initial training before employment can be improved such that the training required upon joining would be reduced. Training providers argued that this can be achieved first and foremost by introducing more realistic training scenarios which are closer to real-life operations. Such scenarios should address the traffic complexities which one may expect in real life.

Another gap which was identified was that aircraft performance during simulator training may not always be realistic. This may eventually lead to trainees finding it difficult to handle aircraft with different performance parameters when they are on the job.

Training providers also agreed that more time should be dedicated to simulator training and that trainees often claim that they feel that the current training regime does not offer enough time to such training.

Gaps and issues identified by employers

Even though initial training may prepare an employee for the job, local training would always be required to cater for differences in the local airspace structure, procedures and systems used. Initial training requirements are regulated and as such should prepare the trainee well enough. Nevertheless, further harmonisation of training requirements may help in possibly reducing the amount of further training required on the job.

Employers also highlighted the fact that awareness of RPAS operations amongst new ATCOs is lacking. Such operations are continuously on the increase and will eventually have to be introduced in initial training for future ATCOs. Employers also argued that rules related to such operations are still not harmonised enough, which in itself makes it harder to train ATCOs for such operations.

2.4.4.3 Airport operations

Gaps and issues identified by employees

Most of the respondents were personnel involved in passenger handling. One of the identified gaps is the lack of adequate training on immigration issues, including the proper checking and control of passports, VISA requirements and other documents. Respondents suggested that further training should also be given on how to deal with passengers, including conflict and complaint resolution.

Employees also argued that training on handling flights manually, which would be required in case of a failure of automated systems, is lacking. This results in employees often having to come up with their own improvised methods, thus creating confusion.

Employees also suggested that training should be more focussed on the required tasks and address deficiencies which individual trainees may have. Whilst not formally mentioned by the participants themselves, this suggests that, in the area of airport operation training, EBT may also prove to be beneficial.

Personnel working in the area of Aircraft Rescue and Fire Fighting (ARFF) mentioned that more practical training is required.

Gaps and issues identified by training providers

Training providers mainly commented on the necessity to focus training on both the use of automated systems and the management of situations where such systems fail. The latter is in agreement with what the employees themselves described. Training providers also mentioned that more training is required in emergency response and management.

Gaps and issues identified by employers

No such information was available. This is probably due to the lack of proper pre-employment training programmes for such airport operations, resulting in employers having to train new employees themselves.

2.4.4.4 UAS operations

Gaps and issues identified by employees

Employees engaged in UAS operations stated that more practical training is required. They also mentioned that instructors who are knowledgeable in such operations are lacking and, most often, instruction is given my former flight instructors. Training must also focus more on safety-related issues besides the operational aspect.

Gaps and issues identified by training providers

The main issue highlighted by training providers is the limited amount of approved training organisations that exist for UAS operations. Furthermore, the quality of such training varies amongst different training providers. This is further exacerbated by the fact that no adequate and harmonised regulatory guidance material exists.

Training programmes were described as not responding adequately to the requirements of real-world operations and rarely address the specifics of the fields in which UAS are used. Training providers thus suggested that training programmes need to be more applied to particular areas of operations, such as surveying and agriculture.

It was also noted that military UAS operations are quite advanced, and it is thus assumed that training programmes for such operations are probably quite well-structured. This suggests that training for civil

UAS operations may be improved by looking at the military counterpart and adapting training accordingly.

Gaps and issues identified by employers

Employers commented that initial training may be focussing too much on the technical aspect without giving due importance to other aspects such as soft skills. They argued that hard skills and soft skills may be disjointed and need to be properly integrated during training.

Employers also commented on the lack of interdisciplinarity in training and stated that knowledge has to be acquired in multiple areas.

A summary of the key training gaps and issues identified by each group of VET users is presented in Table 3.

Table 3 - Summary of gaps and issues identified by VET users

VET users	Gaps and issues
Flight crew	Employees • Limited human factors training • People skills • Passenger interaction • Training focusses mostly on single pilot skills • Limited simulator time and abnormal scenario training • Abnormal scenario training is repetitive and predictable • More importance to basic flying skills • Airmanship and decision-making skills • Flight instructor training is done with another flight instructor (i.e. no students involved) • Flight instructors not necessarily experienced in the industry • Outdated training regime which lags behind techonological advancement • Lack of workplace exposure Training providers • Balance between theoretical knowledge and practical skills • Regulations are too prescriptive and restrictive • Misalignment between regulatory bodies and the industry • More focus on essential areas (e.g. UPRT) • Review of basic instrument flying skills • Fundamentals of the airline industry Employers • Outdated training regulations • Evidence Based Training
Air Traffic Control	Employees • Human Factors training • Stress and workload management • Training programmes too prescriptive and repetitive • Training should focus more on problem-solving scenarios • Balance between theoretical knowledge and practical skills, • Limited simulator time • Simulated scenarios should be more realistic • Inclusion of multi-tasking and handover techniques, teamwork and collaboration • Instructors should be current ATC practitioners • Lack of workplace exposure Training providers • Initial training is too generic • More realistic training scenarios are required • Aircraft performance in simulator training is not always realistically represented • Limited simulator training Employers • Further harmonisation of training requirements may reduce the amount of local training • Awareness of RPAS operations
Airport operations	Employees • Lack of adequate training on immigration issues; document checking and control • Handling of passenger complaints and conflict resolution • Manual flight handling to cope with failure of automated systems • More focus on essential tasks and addressing of individual deficiencies • More practical training for ARFF personnel Training providers • Lack of training in the use of manual systems in the event of automated system failures • Emergency respsonse and management Employers • No information available
UAS operations	Employees • More practical training is required • Lack of specific RPAS instructors • Training should focus on safety-related issues besides operational issues Training providers • Limited amount of RPAS approved training organisations

VET users	Gaps and issues
	• Quality of training organisation is variable • No adequate and harmonised regulatory guidance exists • Training programmes do not address real-world operations Employers • Initial training is too focused on the technical aspect • Lack of training of 'soft skills' • Lack of interdisciplinarity

2.5 Adapting to the workplace

While the training obtained prior to employment can help an individual to prepare for the workplace, employees will still have to adapt to their specific working environment and undergo further training during employment. This section begins by exploring the gaps and challenges experienced by VET users and target groups in the workplace, and the methods used to overcome those challenges. Then it investigates the types of training and assistance provided by employers; the relative importance of different competency areas and skills; and the factors which affect an individual's ability to adapt to the workplace.

2.5.1 Challenges and gaps experienced at the workplace

In the online survey, respondents were given a list of challenges associated with a new job and asked to select one (or more) items from the list according to what they experienced when starting their current job. A radar chart showing the percentage of respondents who selected each of the challenges in the list provided, is shown in Figure 7. The challenge *'Understanding of company policies, procedures and processes'* was selected by the highest percentage of respondents in the case of flight crew, air traffic control and airport operations.[3] The challenge *'Adaptation to company culture / office politics'* was selected by the highest percentage of respondents in the case of UAS operations. These results are not surprising because every company has its own specific ways of doing things, and every organisation is made up of a different mix of people.

Participants of the survey and structured interviews were also allowed to describe other challenges and gaps not included in the list, as well as ways in which they overcame these challenges. The rest of this section describes the challenges and gaps experienced by different VET users and target groups.

[3] In the case of airport operations, the same percentage of respondents selected *'Understanding of job roles and responsibilities'*.

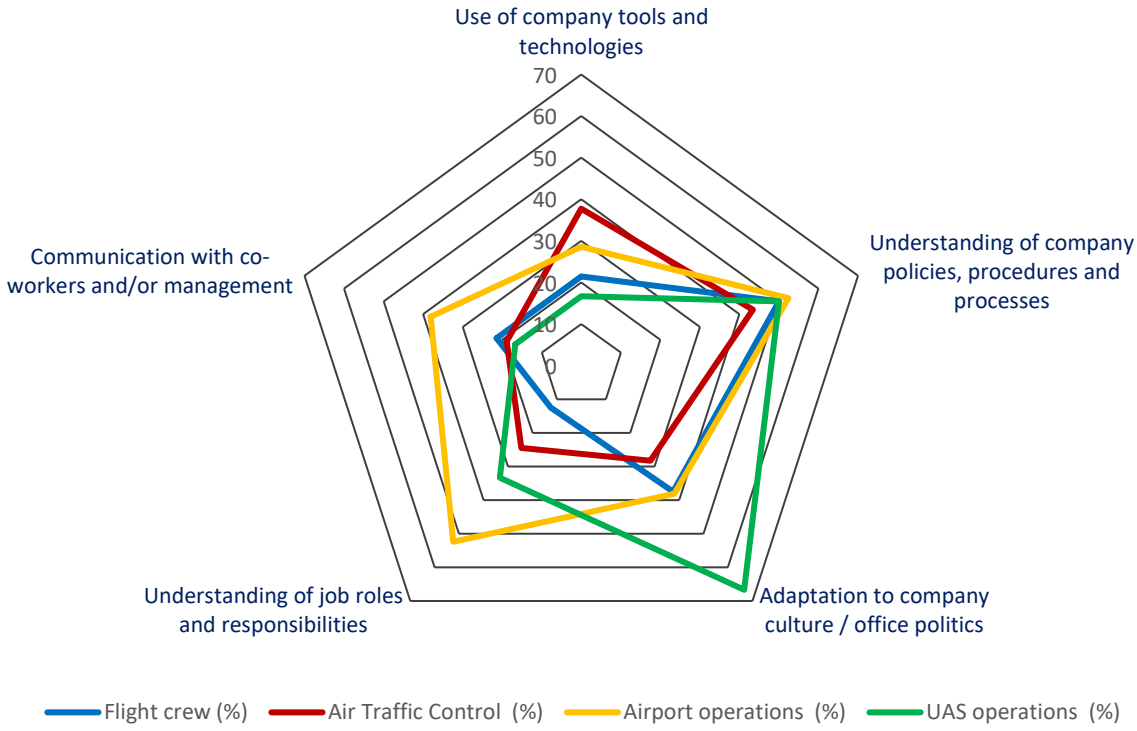


Figure 7- Challenges experienced when starting a new job

2.5.1.1 Flight crew

Challenges identified by employees

One of the challenges identified by employees is related to technical know-how. For instance, new employees need to build up knowledge of the specific type of aircraft which they are flying, and its systems (e.g. CPDLC). This is particularly challenging because new flight crew would normally be transitioning from piston aircraft (used in training) to jet aircraft, with jet aircraft flying faster and being much more complex than piston aircraft. However, this challenge is not only limited to new employees. Experienced flight crew face a similar problem when switching to a different aircraft type, or a different family of aircraft (e.g. from Boeing to Airbus). Some pilots feel that it is easier to switch companies and still fly the same aircraft, rather than remain with the same company and switch to a different aircraft.

Another technical challenge reported by employees is the fact that the real-world exposes employees to flight scenarios which they may not have encountered during training e.g. certain weather patterns. This may lead to difficulties in interpreting weather.

Another challenge is related to the fact that new employees are working in a commercial operational environment and therefore have many other responsibilities apart from the task of flying the aircraft. These include: following company SOPs; handling a large aircraft with crew and passengers; dealing with customers (customer care); and dealing with technical and maintenance issues on the ground. Some respondents stated that it may be necessary to handle conflicts between certain aspects of their role e.g. between security (or safety) and aircraft management. Once the aircraft takes off, the pilot becomes an official and legal officer. If, for instance, there is a quarrel in the cabin, the pilot must make a decision but he/she must do so without going out of the cockpit (for security reasons), delegating this task to a flight attendant.

The aviation sector is very dynamic and, in fact, another challenge identified by employees is that of handling changes in industry policy (regulations) and company SOPs. This can lead to self-doubt when changing to new procedures, and difficulties in understanding documentation.

A number of challenges identified by employees are related to human factors. These include: dealing with workload and stress; time management; fatigue; negative training; and handling conflicts with colleagues (including captains and instructors). These challenges were particularly problematic in the 80s (when little importance was given to Human Performance Limitations (HPL)) but are still present today.

Other challenges identified by flight crew employees include: logistical challenges (e.g. finding a hotel to stay before/after a flight) and getting used to geo-political influences in the parts of the world that the company operates from/in.

Challenges identified by training providers

The following challenges were identified by training providers:

- Dealing with foreign cultures;
- Assessing the individual training needs of students;
- Fitting flight training in a tight schedule (e.g. completing PPL flight training in just 8-9 weeks).

Challenges identified by employers

One of the challenges mentioned by employers is similar to that identified by employees i.e. that new employees (pilots) are now working for an airline, not just practising skills, and therefore they have a wider range of responsibilities.

Another challenge mentioned by employers is related to the recruitment process, where employers stated that they are not always sure about the pilots joining the airline. This is especially true for pilots who are already licenced and type-rated on the aircraft type when they join the airline (as opposed to pilots following an airline cadet pilot programme). In this case, the airline was not involved in the pilots' training and has little background information about the pilots' character and attitude. This information cannot be easily inferred from the licences held by the pilots and, therefore, the airline needs to find out that information in some other way.

Another challenge is related to pilot roles and responsibilities which are normally determined in accordance with operator manuals and approved by enterprises according to existing rules. Additional assignments (which deviate from the defined responsibility areas) create discontent. Therefore, the notion that everything is written down (documented) may create issues.

2.5.1.2 Air Traffic Control

Challenges identified by employees

Various challenges identified by ATC employees are similar to those identified by flight crew, including challenges related to technical expertise, regulations, and human factors. Other challenges are more specific to ATC.

In terms of technical expertise, one of the challenges is caused by a lack of knowledge of technical systems, and another is due to the quantity of vocabulary and acronyms used in radio communications. In fact, new employees find it challenging to speak to an aircraft and to listen to (and understand) live traffic on a radio frequency. In terms of regulation, the challenge is to keep track of the frequent changes in regulation and to understand the hidden implications of regulations and norms.

ATC employees reported a number of human factor challenges, including: dealing with high workload situations (such as when reaching the limit of how many aircraft one can handle in a CTR); managing staff; multitasking; being confident in executing one's own work; dealing with the sense of being alone and being responsible for one's own decisions; and dealing with different characters and mindsets. Several respondents stated that new employees may be influenced by existing employees who may have different customs and who may tell new employees to 'forget everything you learned'. A number of controllers also mentioned that there exists an unofficial hierarchy where the First Controller is always right (even if he/she is wrong).

Differences between training and real-life also pose challenges to new ATCOs. For instance, one controller mentioned that static weather was used during training, whereas weather is dynamic in real life. Another controller mentioned that there are also cases where theory and practice not only do not coincide, but also contradict each other.

Another challenge mentioned by ATC employees is the handling of non-routine/emergency situations (e.g. due to a technical or meteorological situation).

Challenges identified by training providers

The challenges identified by training providers relate to instructor behaviour and preparation, student age and background, and classroom size:

- Behaving correctly in front of students and finding the right balance without getting too involved with them;
- Teaching very young students;
- Adapting to an audience of new students without an ATC background;
- Not having enough time to learn the training material (before passing it on to students);
- Dealing with a larger group of students than expected – This may lead to logistical issues e.g. the use of certain connected training tools.

Challenges identified by employers

Similar to what was stated by ATC employees, employers mentioned that experienced employees may resist change and this can make life difficult for new controllers who are dynamic and proactive.

According to employers, new controllers also face a technology gap. This is due to the fact that they arrive at a workplace which was created several years (e.g. 20 years) prior and which, as a result, is not equipped with the latest technology, or technology which is different from what they were trained on. In addition, employers mentioned that the workplace design is not user-centered and not ergonomic.

Employers also mentioned that, for new employees, the time to get qualified puts a lot of pressure on them as a lot is at stake (income, etc.). Other challenges faced by new employees are due to a lack of interpersonal skills (in certain cases), and a lack of in-depth knowledge of the function in which they are working.

Another challenge mentioned by employers is related to the assessment of new employees. Employers stated that the assessment of new employees is not detailed enough to identify a person's competencies and this may mean that the full potential of these employees is not used.

2.5.1.3 Airport operations

Challenges identified by employees

Most of the challenges identified by airport employees are similar to those identified by flight crew and ATC employees, including challenges related to technical expertise, regulations, human factors,

abnormal/emergency situations, and differences between theory and practice. Many employees stated that one of the challenges of new airport operators was to learn how to use technical systems on the job instead of during training.

In terms of regulation, the challenges that were identified are due to a lack of knowledge of regulations (e.g. those related to VISA/immigration requirements, dangerous goods, etc.) or due to ambiguities in the regulations. For instance, one respondent stated that the recommendations of ICAO-Doc.9137 Part 1, to avoid secondary damage to an aircraft during firefighting, are not clear. This makes it harder to make decisions in emergency situations.

Human factor challenges that were identified by employees include: working with other people (i.e. teamwork) and confronting passengers. Other challenges that were mentioned are: handling specific airline restrictions, and handling flight cancellations and long delays.

Challenges identified by employers

One of the challenges faced by airport employers is to find people with the right work ethic, who share the values of the company and fit in the company culture. The airport environment is fast-paced and dynamic and new employees may find it challenging to adapt to such an environment.

One employer mentioned that new airport employees generally lack knowledge of airport operations (as most come in without specific training) and, therefore, one of the challenges that they face is to learn as much as possible on the job. Another issue mentioned by this employer is that new (and existing) employees find it challenging to communicate in English (speaking and writing).

2.5.1.4 UAS operations

Challenges identified by employees

As in the case of the other groups of VET users, one of the challenges identified by UAS employees is related to technical expertise. In particular, UAS employees identified a gap in the manual and practical flying skills of new employees. This affects their ability to handle aspects which are not covered in training (e.g. different wind and weather conditions). In addition, new employees lack knowledge of specific software and planning tools; knowledge of the particular UAV used; and knowledge of standards and standardisation.

Another challenge which was mentioned by UAS employees is related to the execution of activities which have never been done by the organisation e.g. setting up a team, selecting members, and training and testing them in many emergency situations. Involving people in safety management, and management in general, were also identified as gaps.

Challenges identified by employers

According to UAS employers, one of the challenges faced by new employees is due to a lack of understanding of the specific details of the area which they join. This is similar to one of the challenges identified by ATC employers.

Other challenges that were identified are related to practical aspects of the job, including: the ability to solve problems with incomplete information i.e. in an ambiguous context; the ability to assess how long it will take to perform a certain task; and the ability to prioritise tasks.

UAS employers also identified a challenge related to knowledge of airworthiness i.e. what, depending on the specific requirements of the job, makes a machine capable of flying efficiently and safely.

Another challenge which was identified by employers relates to the attitude of new employees and their ability to resist frustration. Often there is no perception that failure is more frequent than success, and this is essential for people working in this area. People need to get out of their comfort zone, take risks, and deal with failure.

A summary of the key gaps and challenges identified by each group of VET users is presented in Table 4.

Table 4 - Summary of gaps and challenges identified by VET users

VET users	Gaps and challenges
Flight crew	Employees • Knowledge of specific aircraft and systems • Handling new scenarios (not encountered in training) • Adapting to a commercial operational environment • Handling changes in industry policy and company SOPs • Human factor issues (workload, fatigue, etc.) • Logistical challenges • Getting used to geo-political influences Training providers • Dealing with foreign cultures • Assessing training needs of students • Completing flying training according to a tight schedule Employers • Adaptation of employees to a commercial environment • Assessment of character and attitude of new pilots
Air Traffic Control	Employees • Knowledge of technical systems, vocabulary and acronymns • Communicating with live traffic • Human factor issues (high workload, multitasking, etc.) • Influence of existing controllers on new employees • Differences between training and real life scenarios • Handling of non-routine/emergency situations Training providers • Behaving correctly in front of students • Teaching very young students or large groups of students • Adapting to students without an ATC background • Learning training material before passing it on to students Employers • Resistance to change by experienced controllers • Technology gap (outdated equipment and unergonomic setup) • Pressure to get qualified • Lack of interpersonal skills • Lack of in-depth knowledge of function of employee • Assessment of new employees
Airport operations	Employees • Learning how to use technical systems on the job • Lack of knowledge of regulations (VISA/immigration requirements, etc.) • Regulation ambiguities • Human factor issues (working with people, confronting passengers, etc.) • Handling specific airline restrictions • Handling flight cancellations and delays Employers • Finding people with the right work ethic • Adaptation of new employees to the fast pace of an airport environment • Learning about airport operations • Communicating in English (speaking and writing)
UAS operations	Employees • Lack of manual/practical flying skills • Lack of knowledge (software and planning tools, standards, etc.) • Executing new activities • Involving people in safety management • Management Employers • Lack of understanding (by employees) of the area in which they are inserted • Dealing with practical aspects of the job (problem solving, task prioritisation, etc.)

	• Lack of knowledge of airworthiness • Dealing with frustration and failure

2.5.2 Overcoming challenges and gaps

Apart from identifying gaps and challenges in the workplace, the respondents were asked to describe ways in which they approached, or overcame, them. From Table 5 it can be observed that a few approaches are common between different groups of VET users, including: asking other people for assistance, referring to documentation, and using a 'trial and error' approach.

One of the respondents mentioned that the lessons learnt from certain experiences (e.g. emergencies) are used to update processes and procedures. It is important to note that several respondents of the survey and interviews (particularly flight crew and ATC) acknowledged that certain challenges can only be overcome with time and experience, implying that certain challenges are unavoidable for new employees. Figure 8 shows the time span required by different VET users to feel sufficiently competent in their job, with the most common response in each group of VET users being 1-6 months.[4]

VET users	**Approaches**
Flight crew	Employees • Turn to other people for assistance, feedback and advice (First Officer, supervisor in charge, in-flight manager, crew, turnaround, chief pilot, etc.) and work as a team • Refer to documentation (operating manuals, etc.) • Train in a simulator (e.g. to practise IFR flying)
Air Traffic Control	Employees • Share personal experience with colleagues • Ask other staff for help (peer assistance) • Consult documentation • Control workload (by saying 'standby' to aircraft, delaying start-ups, etc.) • Use common sense • Improvise Training providers • Tell students that you don't know the answer to a question and give them a reply in the next class • Call out students when they do something wrong (e.g. to stop playing with their phone) • Ask students for technical assistance (e.g. with computers). This teaches them the value of cooperation
Airport operations	Employees • Ask for assistance from colleagues/supervisors and work as a team • Be assertive when confronting passengers

[4] In the case of flight crew, the percentage of respondents who chose '1-6 months' and '7-12 months' was the same (32%).

	• Trial and error
UAS operations	Employees • Consult documents (manuals, etc.) • Use Internet resources (articles, forums, YouTube videos, etc.)

Table 5 - Approaches to overcoming gaps and challenges

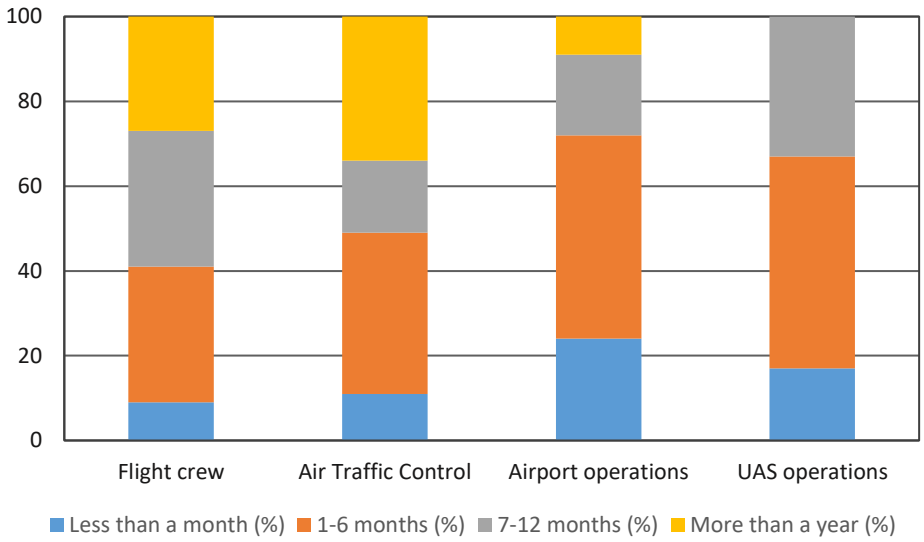


Figure 8 - Time required to feel competent in one's job

2.5.3 *Training and assistance provided by employers*

As explained earlier, the training which individuals undergo prior to employment is not enough and employees will need to keep their knowledge and skills up-to-date throughout employment. For this reason, employers generally provide training to their employees using internal and/or external training providers. When asked whether they received training from their organisation since the beginning of their current job, the respondents replied as shown in Table 6. From this table it can be observed that the vast majority of flight crew, air traffic controllers, and airport operators did receive training, whereas only half of the UAS operators did. The respondents were then asked about the specific type(s) of training which they received during employment. For this purpose they were given a list of types of training to choose from and the results are shown in Figure 9, Figure 10, Figure 11 and Figure 12. In addition, the respondents were asked to list any other types of training which they received and the results are shown in Table 7.[5]

Table 6 - Training received from organisation since beginning of current job

VET users	**%**
Flight crew	93

[5] UAS operators are not shown in this table because they did not list other types of training provided by their employer.

Air Traffic Control	94
Airport operations	86
UAS operations	50

From Figure 9 and Figure 10 it can be observed that technical training, recurrent/refresher training and on-the-job training are the most common types of training for flight crew and air traffic control. In fact, recurrent/refresher training of flight crew and ATC is mandated by law. One of the ATC employers stated that, in certain cases, such as when a foreign training provider is used, 'conversion' training is required to transfer local knowledge to employees and to compensate for differences (in procedures/environments/systems) between the training provider and the employer.

In the case of airport operators, the most common type of training is on-the-job training (job rotation, job shadowing, etc.), followed by recurrent/refresher training. On-the-job training is in fact one of the challenges identified by employees in Section 2.5.1.3. As in the case of flight crew and ATC, recurrent/refresher training of airport operators (particularly those working as security staff, trainers and management) is mandated by law. As mentioned previously, the majority of airport employees do not have any prior training; this is the reason why induction training is mentioned in Table 7.

For UAS operators, the most common type of training provided is technical training.

When employers were asked if they provide assistance for upskilling/reskilling, some said that they do provide assistance, whereas others do not. Support is normally provided when the upskilling/reskilling of the individual is in line with the company's needs and could be in the form of financial assistance, special exam/study leave, etc. Some companies have a policy which encourages hierarchical progression and specialisation, as well as a change of technical roles. In cases where support is not provided, the reasons given include a lack of training budget and/or restrictive work schedules which limit the possibility for upskilling/reskilling.

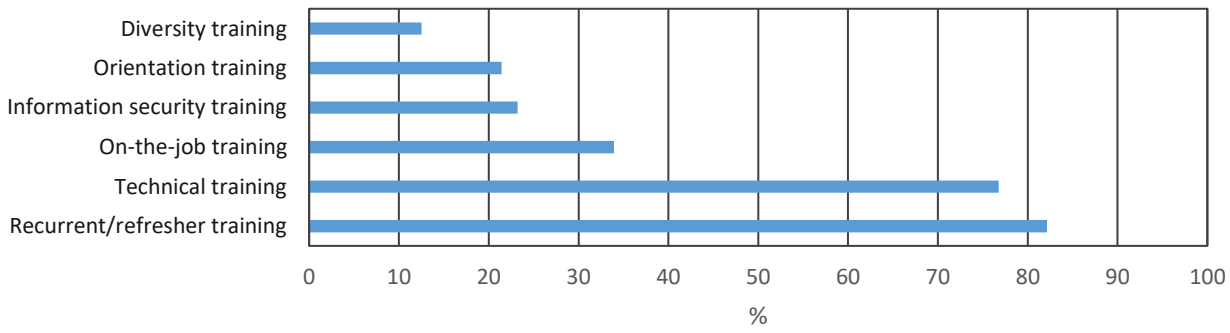


Figure 9 - Training provided by employer (Flight crew)

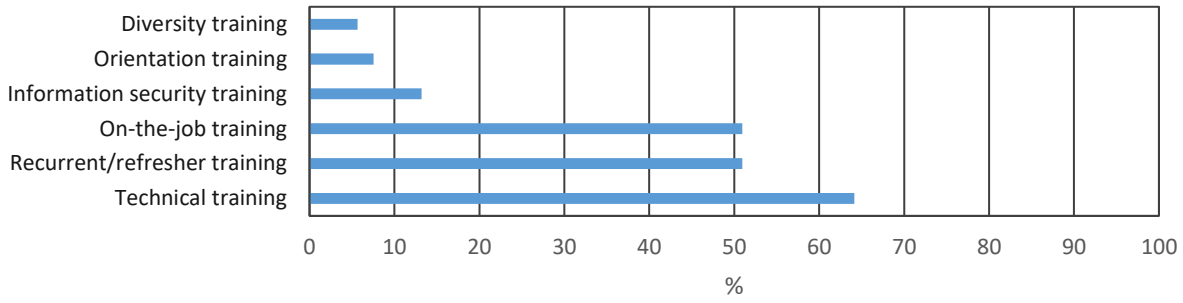


Figure 10 - Training provided by employer (Air Traffic Control)

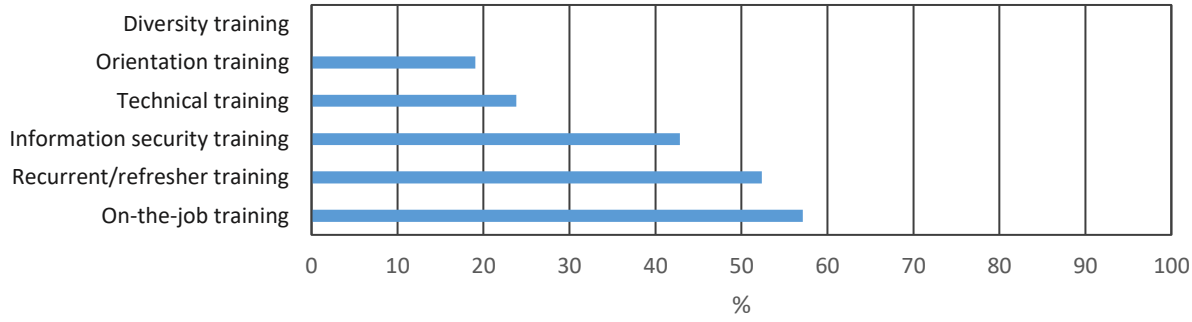


Figure 11 - Training provided by employer (Airport operations)

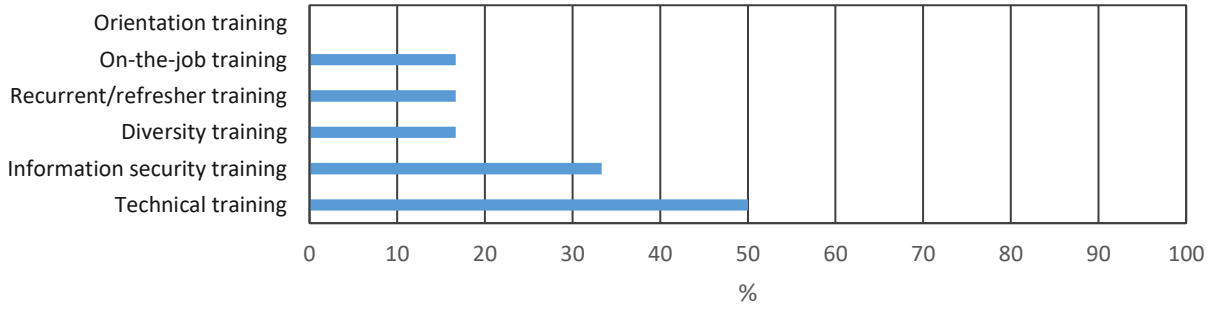


Figure 12 - Training provided by employer (UAS operations)

Table 7 - Other training provided by employers

VET users	Types of training
Flight crew	• CRM training
Air Traffic Control	• Instructor course • Human factors • Teaching methods • New computer system training • Business administration

	• Operational design • Aviation law • Coaching • Facilitation
Airport operations	• Induction course (including airside safety and security, immigration, check-in system, and dangerous goods training) • Leadership training • Visa requirements training • Customer service • Road training • Airline-specific training

2.5.4 Importance of competency areas

The respondents of the survey and interview were asked to rate various competency areas in terms of their importance in the workplace and the results are shown in Figure 13. From these results it can be observed that:

(a) 'decision making' is one of the three most important competencies according to all groups of VET users, and is considered by flight crew to be the most important competency. This is understandable given that bad decisions may have very serious consequences (including loss of life);

(b) 'teamwork and collaboration' is one of the two most important competencies according to air traffic controllers, airport operators and UAS operators, and is considered by ATC to be the most important competency. This is expected given that controllers, airport operators and UAS operators normally work in teams;

(c) 'business acumen' is considered to be the least important competency according to all groups of VET users.[6] This is in line with the roles, responsibilities and priorities of these types of VET users (where safety comes before financial considerations). 'business acumen' is followed by 'researching' in the case of flight crew, ATC and airport operations. This is expected given that people in these groups are not generally expected to do further research beyond the minimum legal requirement.

It is important to point out that the results shown are the average scores of each group of VET users, and that there are certain competencies which may be more relevant to particular roles than others within the same group. For instance, in the case of flight crew, 'leadership, management and planning' would be more relevant to a captain than a first officer. Similarly, in the case of ATC, 'coaching, mentoring and advising' would be more relevant to a team leader than an air traffic controller.

[6] Airport operators rated 'business acumen' and 'researching' equally.

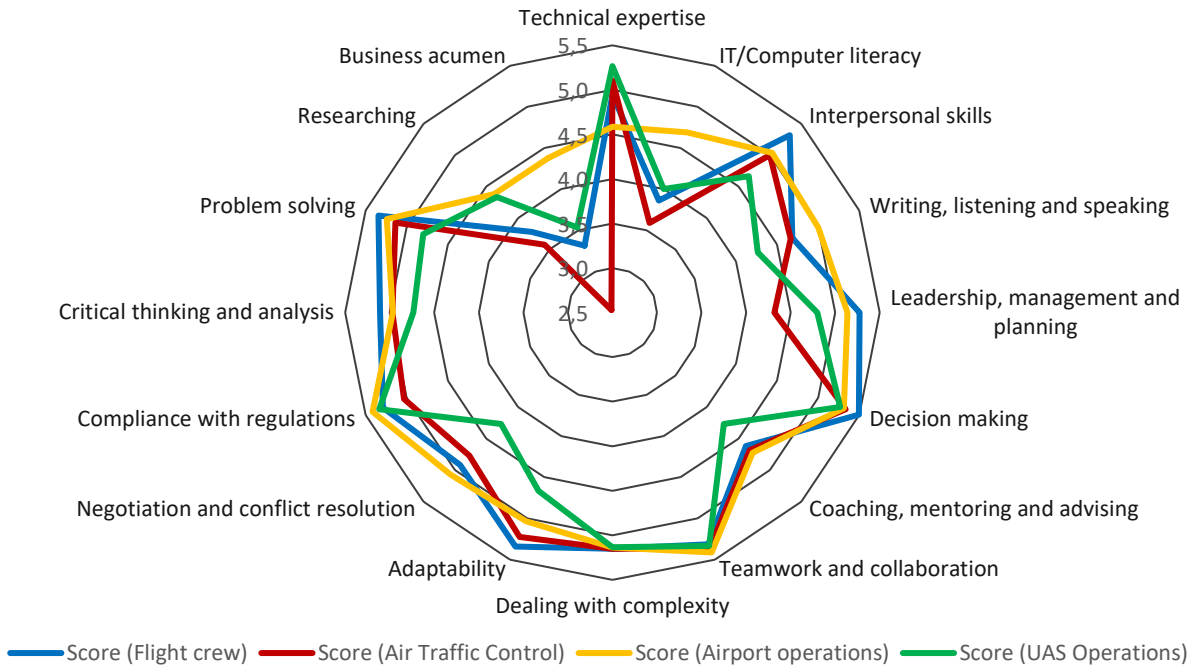


Figure 13 - Importance of different competency areas in the workplace

2.5.5 'Behavioural skills' vs 'technical skills'

The respondents of the survey and interview were asked about the relative importance of behavioural skills (aka soft skills) and technical skills (aka hard skills). The responses obtained show that there is consensus among all the groups regarding the high importance of behavioural skills.

Respondents within the flight crew group stated that soft skills are as important as technical skills. Technical skills are especially important when dealing with challenging situations e.g. weather. In this case, technical skills give pilots more confidence in their ability to handle the situation. On the other hand, behavioural skills are important due to the teamwork environment that pilots work in. Teamwork must be efficient as the airline industry is very competitive. Behavioural skills are also important when dealing with co-workers, customers, and suppliers. The importance of soft skills is also demonstrated by the fact that, in the majority of cases, accidents are related to soft skills. One of the respondents said that pilots generally have technical skills; however, good pilots also have soft skills. Another important point mentioned by flight crew is that technical skills can be taught whereas behavioural skills, such as teamwork and leadership, are harder (and take longer) to acquire than technical skills. This is partly due to the fact that some personal aspects cannot be changed beyond a certain age.

The comments of respondents within the ATC group are very similar to those provided by flight crew. According to ATC respondents, technical skills are important in order to understand ATC tools; on the other hand, behavioural skills (such as teamwork and collaboration) are very important because controllers work in teams to share tasks and responsibilities. In fact, students may fail if they do not demonstrate these skills. Therefore, aptitude and attitude are both important. ATC respondents also share the flight crew's view that soft skills are far more difficult to acquire than technical skills e.g. to find the right balance of authority over pilots or other controllers.

Airport operators share the flight crew's view that behavioural skills are as important as technical skills. Behavioural skills can be particularly useful in emergency situations when time is of the essence and

there is a lot of pressure. They can also be beneficial to prevent or diffuse tension between people in conflicting situations, and help to manage the situation.

UAS operators also generally agree that soft skills are as important as technical skills. This is because the drone operator must know the machine and his/her own limits. For instance, when doing a risk assessment, both technical and behavioural skills are important. During operation, behavioural skills are important because UAS operators need to exercise a high level of emotional control to ensure that they operate safely.

Table 8 summarises the key characteristics and applications of behaviour skills and technical skills.

Table 8 - Characteristics and applications of behavioural and technical skills

Behavioural skills	Technical skills
• Harder to acquire than technical skills • Related to attitude • Applications include: working in a team; understanding personal limits; resolving conflicts; handling emergency situations; conducting risk assessments	• Easier to acquire than behavioural skills • Related to aptitude • Applications include: understanding and using tools/systems; handling challenging/ emergency situations; conducting risk assessments

2.5.6 Adaptability

The respondents of the survey and interview were asked whether they agree with the statement that *'younger employees are more likely to adapt to new processes and technologies in the workplace than older employees'*. The results obtained show that, in general, the respondents agree with this statement and the reasons provided include:

- Younger people are more accepting of new technologies and automation whereas older employees have less trust in new technologies and systems;
- The younger generation is more exposed to technology and is more tech-savvy whereas some of the older employees started working before computers existed;
- Younger people are better prepared in terms of education and have experienced a rapid change in technology;
- Older people are more conservative and any changes would lead them to question methods which they have relied on for years;
- Younger people are more willing to take risks (i.e. they are less afraid of making mistakes) whereas, with age, people become more risk-averse;
- Younger employees have a desire to prove themselves and have more energy than older employees.

As can be observed from the reasons provided above, the greater adaptability of younger employees can be boiled down to: exposure to technology, education and attitude/personality.

Some of the respondents argued that it is not true that younger employees are more adaptible than older employees because adaptability is not a generational issue. Instead, adaptability has a lot to do with an individual's attitude e.g. being open-minded and not resistant to change; being flexible in one's approach; being motivated; and showing an innate interest in learning. Figure 14 shows how the survey respondents rated (on a scale of 1-6, '6' being the highest rating) the impact of different personal attitudes on an individual's ability to adapt to changes in the workplace. From this figure it can be observed that 'motivation' is considered to be one of the two most important personal attitudes among all of the groups of VET users.

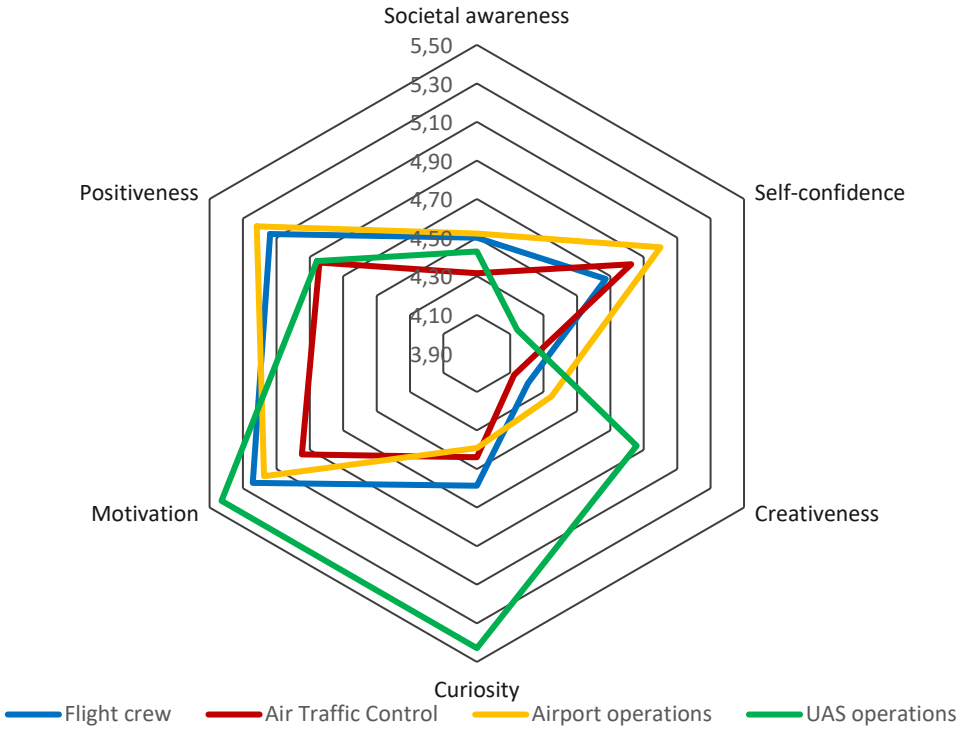


Figure 14 - Impact of personal attitudes on ability to adapt to changes in the workplace

2.6 2030 and beyond

This section focuses on the changes that are expected to occur in the workplace in the near future (2030 and beyond) and their impact on the jobs and skills of each group of VET users.

2.6.1 Foreseen changes in the workplace

The participants of the survey and interviews were asked to identify changes which may occur in the near future, as well as factors which could have an impact on each group of VET users. This section describes the key changes and factors associated with each group.

2.6.1.1 Flight crew

The first type of changes that are expected to affect flight crew are technology-related. The respondents felt that these changes will occur gradually (incrementally), which is usual in commercial aviation. One of the changes that was mentioned is automatic take-off. However, the most controversial and debated technological change is that related to Single Pilot Operations (SPO). Some of the respondents felt certain that SPO will happen because the technology is already there, with some saying that SPO will start with cargo operations. Other participants were less convinced, stating that SPO will occur but only beyond 2030, partly because none of the aircraft currently in production are tailored for SPO. Other participants even went as far as saying that SPO will never occur, at least not in commercial operations, because it is essential to have two pilots in the cockpit.

Other technological changes which are expected to occur – and which will impact flight crew – are related to drones, such as drone transportation. Although not directly related to flight crew, drones will increase the density of airspace and will create challenges for manned aviation.

Changes in regulation are also anticipated. Regulations will need to evolve in order to keep in line with new technologies and to respond to other needs of the industry. For instance, new regulations are coming into force in 2022 in relation to Knowledge, Skills and Attitude (KSA), where students will be assessed on teamwork, multi-tasking, etc., as a prerequisite to commercial pilot training.

Several factors were also mentioned which could lead to changes in the workplace. For instance, the recent COVID-19 pandemic is having, and will continue to have, an impact on aviation. The tourism industry has been hard hit globally, and people are increasingly working virtually. These two factors have resulted in a severe downturn in the demand for air travel. Future contagious diseases could have similar affects. Other factors that were mentioned include: climate change (and other environmental concerns), the economy (cost cutting, etc.), flight training tools, airline policies, and the tightening of security.

2.6.1.2 Air Traffic Control

As in the case of flight crew, a number of technology-related changes are expected to occur, with no disruptive ATC technologies expected until 2030. These changes include: a stripless and fully electronic environment; remote towers (small ATC centres will be grouped and remote towers will become more common); and an increase in assistance systems for ATC (including systems powered by AI). Other technologies were mentioned which are not directly related to ATC but which will nonetheless have an impact on ATC operations. These include drones (and Remotely Piloted Aircraft Systems (RPAS)) and urban air mobility.

New regulations and procedures are also anticipated. These will be due to new technology as well as other non-technology-related matters e.g. noise abatement, direct routing, time-based separation, and Required Navigation Performance (RNP).

As in the case of flight crew, changes due to the environment (ecology, climate change, etc.), economy and contagious diseases are expected. One of the respondents suggested that the current slowdown due to COVID-19 can be used as an opportunity to restructure at a technology and procedural level, something which was challenging pre-COVID due to the great growth in air traffic.

Other changes and factors which could have an impact on the workplace were mentioned, including: societal changes; staff shortages (due to the general public's lack of knowledge of the work done by controllers); financial restrictions (which may affect the amount and/or quality of training); the upwards expansion of the airspace; bureaucracy; and diplomatic relations between countries.

2.6.1.3 Airport operations

As in the case of flight crew and ATC, it is expected that a number of changes in technology and regulation will occur. New technologies will be introduced gradually and will include greater airport automation (self-check-in machines, robots, unmanned vehicles, etc.) and mobile technologies. Contagious diseases (such as COVID-19), and their impact on the global economy, were also identified by several respondents as a factor which could lead to changes in airport operations.

2.6.1.4 UAS operations

In contrast to the other groups of VET users, the technology developments related to UAS operations are expected to be disruptive. One of the respondents stated that major developments are expected in the next 1-2 years as technology is constantly changing and more and more people are using drones for recreational purposes. AI will play a bigger role in drones and improvements will occur in various UAS aspects such as: endurance, payload capability, sensors, autopilots, and navigation tools.

The number and complexity of systems on a UAS will pose challenges to standardisation and safety/security conformity assessment. The low cost of vehicles and systems, together with accelerating

development call for new risk classification schemes (partially achieved by EU directives 2019/945 and 2019/947) and certification schemes to support the aviation industry and authorities.

The number of drones will increase and swarms of drones will become a reality, making it difficult for air traffic controllers to manage them. As a result, Unmanned Traffic Management (UTM) will need to be implemented and regulated. Regulations will cover aspects such as: 'Drone Traffic Zones' over urban areas with their UTM systems; priorities within airspace (between drones, as well as between drones and manned aircraft); privacy; and liability.

Societal changes will also impact UAS operations. For instance, currently, there is hesitation to fly drones over crowded areas. However, with time, society may come to accept greater risk in return for the benefits offered by drones e.g. delivery of medicines and basic supplies. As a result, by 2030-2040, drones will be used instead of trucks for downtown deliveries.

As can be observed from Section 2.6.1, technology will be one of the key drivers of change. In the case of UAS operations, new technology will be disruptive whereas, in the case of the other VET users, it will be more incremental. Regulations – which affect all groups of VET users – will be partly driven by new technology but will lag behind technology. Drones/RPAS will not only affect UAS operations but also flight crew and ATC. A summary of the changes and factors which will impact each group of VET users is shown in Table 9.

Table 9 - Summary of changes and factors which will impact VET users

VET users	Changes and factors
Flight crew	• Technology (automatic take-off, SPO, etc.) • Drones and drone transportation • Regulation (KSA, etc.) • Contagious diseases • Climate change • The economy • Training tools • Airline policies • Security
Air Traffic Control	• Technology (remote towers, assistance systems, etc.) • Drones/RPAS • Urban air mobility • Regulation (noise abatement, direct routing, RNP, etc.) • Contagious diseases • Climate change • The economy • Societal changes • Staff shortages • Financial restrictions • Expansion of the airspace • Bureaucracy
Airport operations	• Technology (self-check-in machines, unmanned vehicles, etc.) • Regulation • Contagious diseases
UAS operations	• Disruptive technology • Swarms of drones • Drone transportation • Regulation (risk classification, certification, UTM, etc.) • Societal acceptance

2.6.2 Impact on jobs and skills

The participants of the survey were asked to rate a number of changes and developments in terms of their level of impact on jobs associated with each group of VET users. The results are shown in Figure 15. The top three factors which are considered to have an impact on jobs associated with each group of VET users are given below.

Flight crew: (1) automation; (2) growth in manned and unmanned air traffic; (3) regulation;

Air Traffic Control: (1) growth in manned and unmanned aerial traffic; (2) regulation; (3) automation;

Airport operations: (1) regulation; (2) cybersecurity; (3) growth in manned and unmanned air traffic;

UAS operations: (1) growth in manned and unmanned aerial traffic; (2) regulation; (3) big data and AI.

As can be observed, both 'regulation' and 'growth in manned and unmanned aerial traffic' are considered to have a big impact on all groups of VET users.

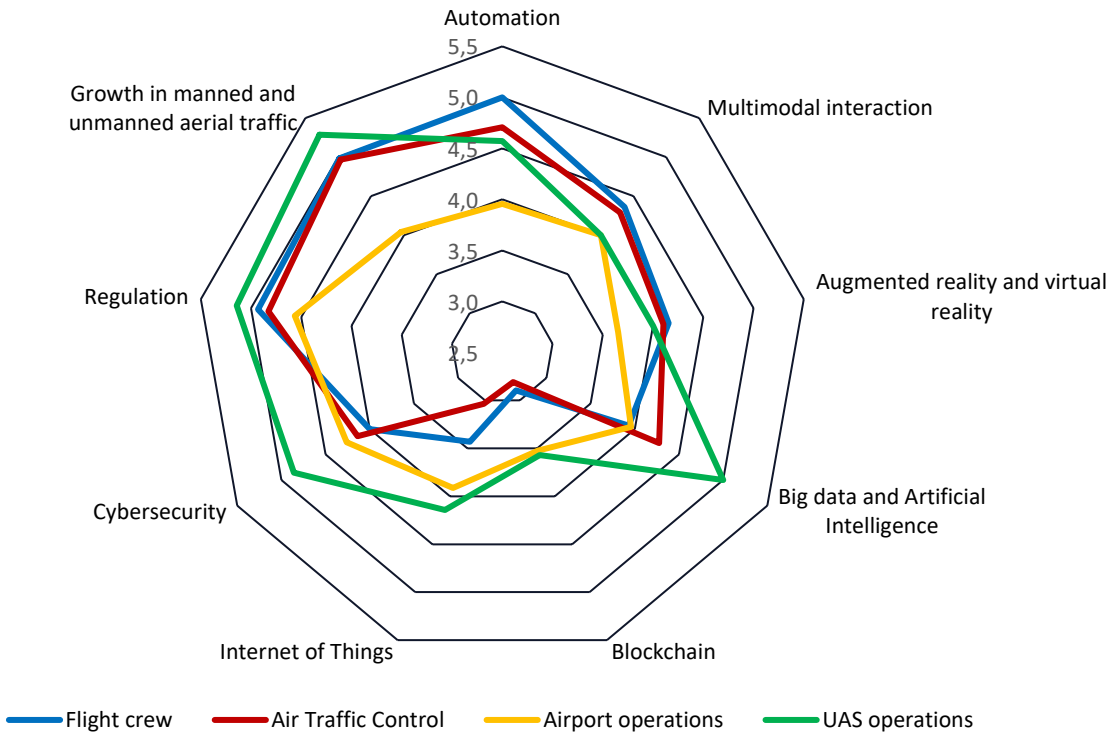


Figure 15 - Impact of different factors on each group of VET users in the near future

The survey participants were also asked to state how much they agree with the statement that their jobs will change significantly in the near future. The results are shown in Figure 16 and, as can be observed, the majority of participants in each group of VET users tends to agree with this statement, especially those involved in UAS operations. This is partly due to the fact that, as explained in Section 2.6.1, UAS technology is changing at a rapid pace.

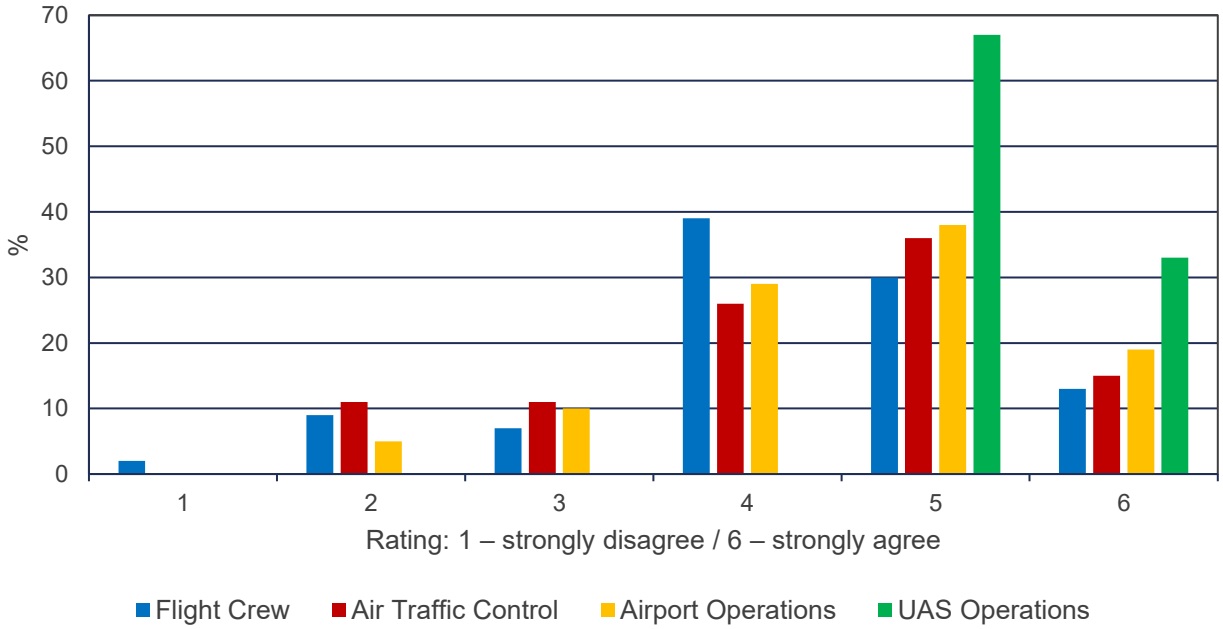


Figure 16 - Response of survey participants to the statement 'My current job will change significantly in the near future'

The rest of this section explains how the changes and factors described in Section 2.6.1 will affect the job roles, responsibilities and skills requirements of each group of VET users. It also identifies jobs that will be potentially created and others that may change and even become obsolete.

Flight crew

Certain flights which are currently manned (firefighting, coastal surveillance, oil pipe inspections, etc.) will become unmanned, replacing pilots (e.g. helicopter pilots). However, in general, the repondents felt that pilots will not become obsolete. The concept of an airline pilot will change a lot though, partly due to more automation and AI, with automation potentially taking decisions on its own without pilot input. Thus, there will be greater reliance on automation. As a result, pilots will need to be able to interact with machines and understand automation, including AI systems. The crew will still need to remain critical and should be able to prioritise tasks. Also, pilots will need to be more situationally aware, as it is easier to become distracted with more on-board automation.

Since there will be less human intervention in the flight deck, the level of threats caused by human factor issues will decrease. At the same time, however, the pilot will become the last safety defence. Therefore, hands-on flying skills will still be needed to deal with emergencies.

Due to the increased level of automation, some of the respondents argued that the pilot's job description will become less technical and more about management of equipment and people. However, other respondents argued that more technical and IT knowledge will be required. Those who argued that the pilot's role will become less technical stated that the pilots will require more operational knowledge and interpersonal skills. Management skills and capabilities (including handling of complex situations) will be more important because the world is becoming more complex and it will require more and more leaders and managers that can deal with this complexity.

Technology and AI will not only affect the cockpit but it will also change the way pilot training and assessment is carried out. For instance, at the moment, there is a level of judgement by the instructor during simulator training/checking. However, now there is a shift towards the use of sensors which can tell the instructor how accurately/precisely the flying is being done. This can be used to determine exactly what areas need to be improved.

As explained previously, the introduction of SPO is debatable and will naturally impact pilots if/when it is introduced. The biggest challenge to SPO will be reliability and social/cultural acceptability. In a single pilot cockpit, the pilot will be more isolated and will need to be more critical. The risk is that this will result in more individualistic persons with a lack of team spirit.

Adaptability will be important because the airline industry needs to improve continuously to keep up with passenger demands at an affordable and competitive price. Pilots will also need to adapt to new ways of working, the quicker the better. In fact, when the flight crew respondents were asked what knowledge and skills they think will be most in demand in the near future, the most frequently mentioned skill was adaptability – at a personal level and an organisational level. Other commonly mentioned skills were: technical knowledge/skills, IT skills, interpersonal skills, and resilience.

Air Traffic Control

As in the case of flight crew, the respondents in this group feel that ATCOs will not become obsolete but their role will continue to evolve. The role of controllers will be primarily impacted by changes in technology and regulation.

Regulations will probably add more and more constraints, so knowledge of regulations will be even more critical. On the other hand, technology is becoming more and more complex, so technical and IT-related

skills will also become more important. Controllers will need to accept new technology, learn about it and learn how to use it. Therefore, technology acceptance will be very important.

The role of controllers is transitioning from a purely operational role (that requires interaction with aircraft) to a role of managing complex systems i.e. from control to management, or ATC to Air Traffic Management (ATM). The role of controllers will become more about monitoring and validating decisions proposed by automation. However, the issue is what to do when automation fails. Thus, there will need to be more training for degraded or unusual situations. These situations will become rarer but will be more challenging to handle precisely because they are rare and controllers are not used to them.

The increase in air traffic will affect procedures and working methods. Adaptability, technical skills, and interpersonal skills will be particularly important to handle this.

With the introduction of remote towers for small airports, the controller will need to have a broader set of skills as he/she will have to do everything. In contrast, there will be more specialised training for controllers working at larger airports.

As in the case of flight crew, when the ATC respondents were asked what knowledge and skills would be most in demand in the near future, the most frequently mentioned skill was adaptability. Other commonly mentioned skills were: IT and technology-related skills, technical expertise, compliance with regulations, and interpersonal skills.

Airport operations

Given the increase in automation, airport operators will need much more automation training. This is necessary to match the gains in efficiency obtained through automation. It is important that airport operators understand how automation works, how to control it, and how to identify any potential issues.

Airport operators will also need to gain more expertise in managing health emergencies (i.e. emergency management), not only those linked to accidents but also to epidemics, since diseases can spread much more rapidly through air transport. There needs to be better communication between airport authorities and healthcare authorities.

Some of the respondents believe that certain airport jobs will become obsolete whereas other jobs will be unaffected. For instance, in airport emergency situations, important decisions have to be taken and it is unlikely that this will be done without involving human beings. However, automation (e.g. automated vehicles) may reduce the number of people required to handle an emergency. Similarly, jobs which require human interaction and coordination (e.g. terminal management) will not be affected, whereas other jobs (e.g. check-in) will be replaced by automation. Individuals with high Emotional Intelligence (EQ) will be valued more than those with high Intelligence Quotient (IQ) because it is harder to automate tasks where EQ is required.

Some jobs may also be created as a result of technology and automation. One of the respondents stated that, whenever new technology was introduced, new jobs were created to handle the technology. For instance, if robots are used to do certain inspections, there will still be a need for human action (e.g. robot maintenance or data analysis). Therefore, new opportunities will be created for employees and up-skilling will be required.

The rate at which new technology will be introduced (and have an impact on jobs) will vary from one country to another. For instance, in certain countries, salaries are relatively low and therefore the incentive to introduce automation is also less than in other countries.

When the respondents in this group of VET users were asked what knowledge and skills would be most in demand in the near future, the most frequently mentioned skills were IT and technology-related skills. Other commonly mentioned knowledge and skills were: AI, communication and adaptability.

UAS operations

In the near future, drones will probably be easier to pilot and their capabilities will increase. As a result, the drone pilot will need to have more technical and IT skills. The current role of the drone pilot may become redundant since it will be replaced by that of an operator who monitors and supervises the mission of a drone flying autonomously. This will have strong ethical, technological, regulatory and social implications. Drone operators will need to understand the data given by the drone interface and develop situation awareness.

Despite the increase in automation, the ability to fly a drone manually will still remain important because a human operator will need to be able to override the "autonomous" mode of operation and ensure airworthiness of all operations. Therefore, operators will need to be trained to operate a drone manually and they must do so often enough to maintain their piloting competencies. Drone operators will also need to be more competent, especially when dealing with ambiguities and unforeseen events which are not handled well by automated systems.

Some of the respondents argued that pilots with a mix of manned and unmanned aircraft experience will be more employable. This is partly because, within the scope of risk and safety analysis, there is a lot of knowledge and skills which can be transferred from manned aviation to drone/RPAS operations.

Certain jobs in the area of unmanned aviation will become obsolete but new jobs will be created, including jobs related to planning, forecasting, maintenance, and management. Also, as mentioned before, some jobs which are currently carried out with manned aircraft will be increasingly carried out using drones.

According to this group of VET users, the knowledge and skills that will be most in demand in the near future are IT skills and computer literacy. Other commonly mentioned knowledge and skills were: technical expertise, planning, situation awareness, and decision making.

Apart from identifying the most in-demand knowledge and skills in the near future, the respondents of the survey and interviews were asked whether the importance of different competency areas will change. The results obtained for each group of VET users are shown in Figure 17, Figure 18, Figure 19 and Figure 20. The top three competency areas which are expected to increase in importance for each group of VET users are given below.

Flight crew: (1) dealing with complexity; (2) adaptability; (3) IT/computer literacy;

Air Traffic Control: (1) IT/computer literacy; (2) adaptability; (3) technical expertise;

Airport operations: (1) IT/computer literacy; (2) technical expertise; (3) problem solving;

UAS operations: (1) technical expertise; (2) dealing with complexity; (3) adaptability.

As can be observed, adaptability, IT/computer literacy and technical expertise are three competency areas whose importance is most likely to increase for three of the groups of VET users.

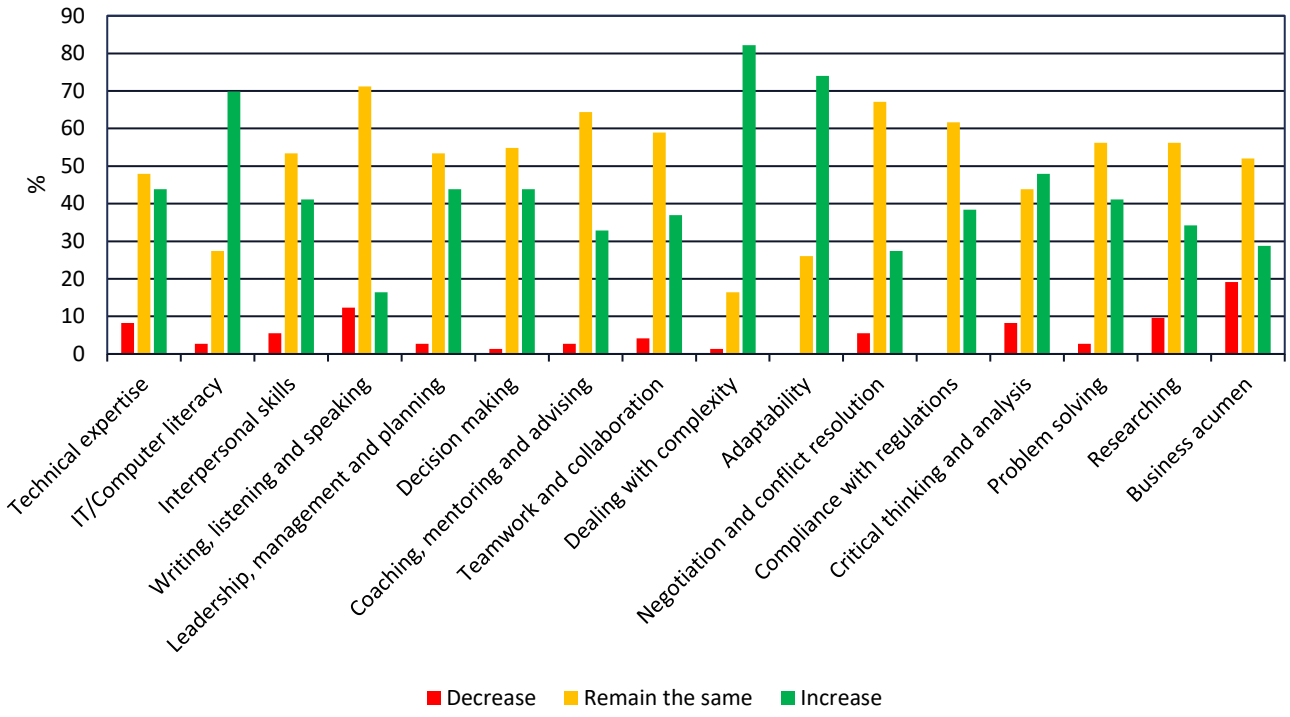


Figure 17 - Change in importance of competency areas in the near future (flight crew)

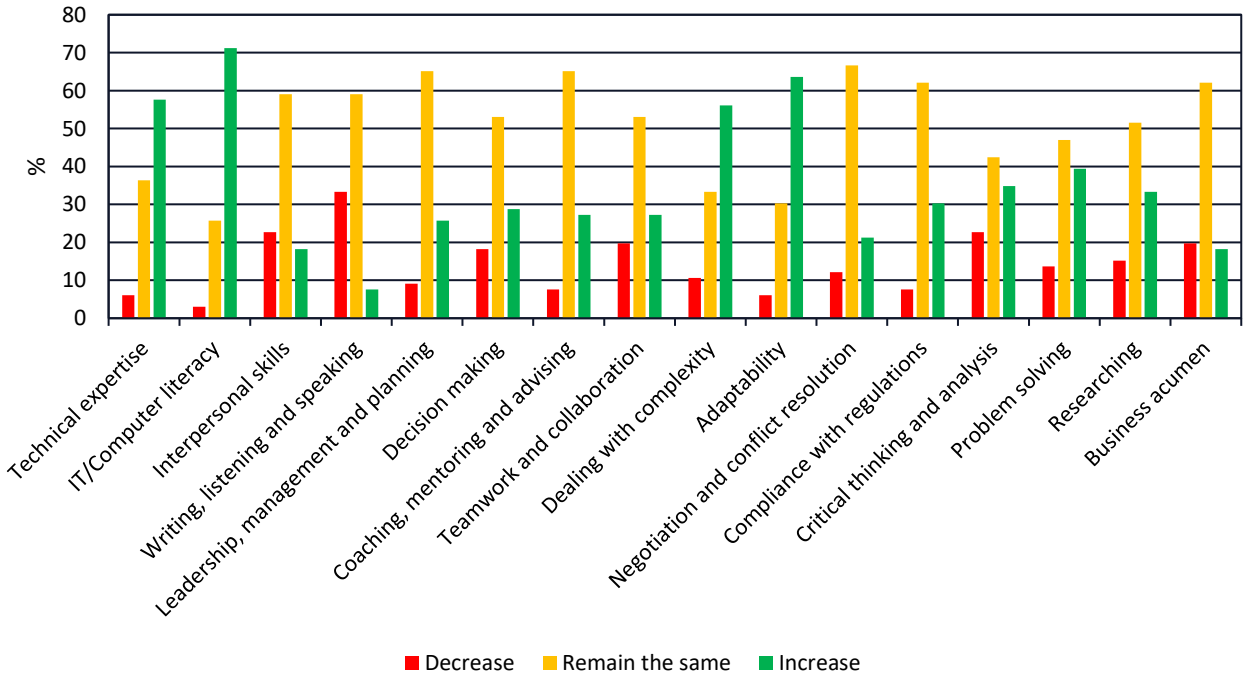


Figure 18 - Change in importance of competency areas in the near future (ATC)

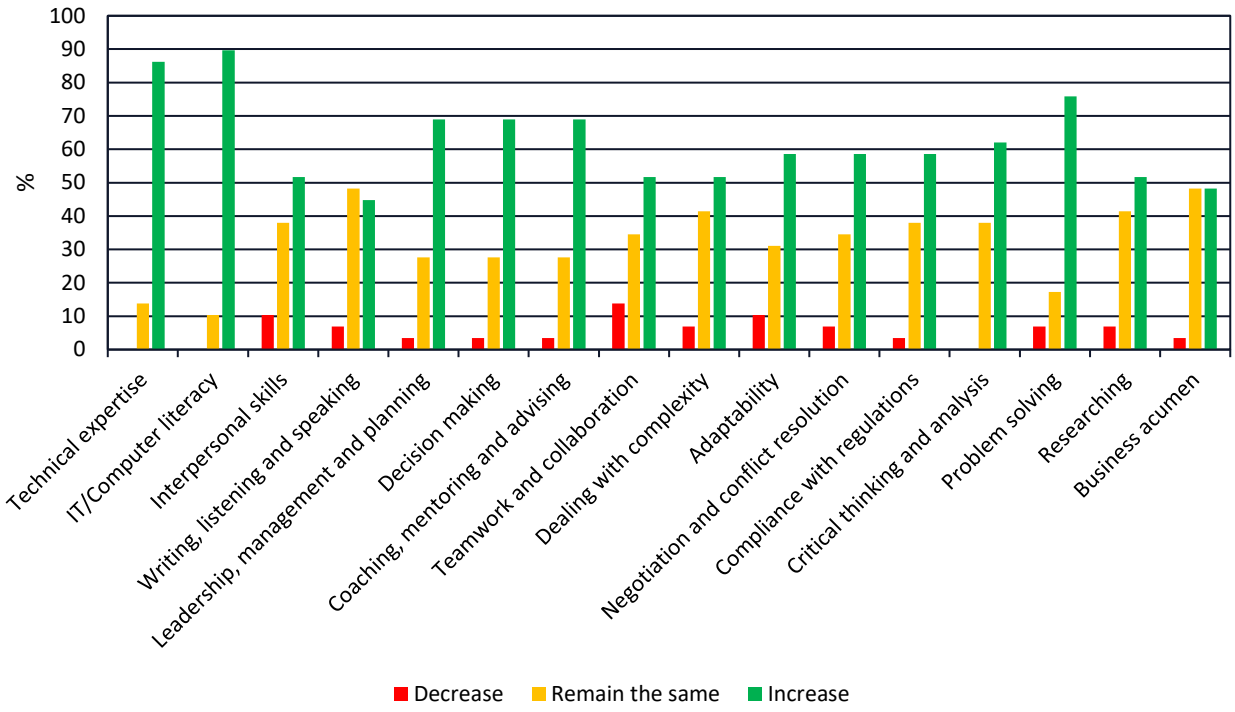


Figure 19 - Change in importance of competency areas in the near future (airport operations)

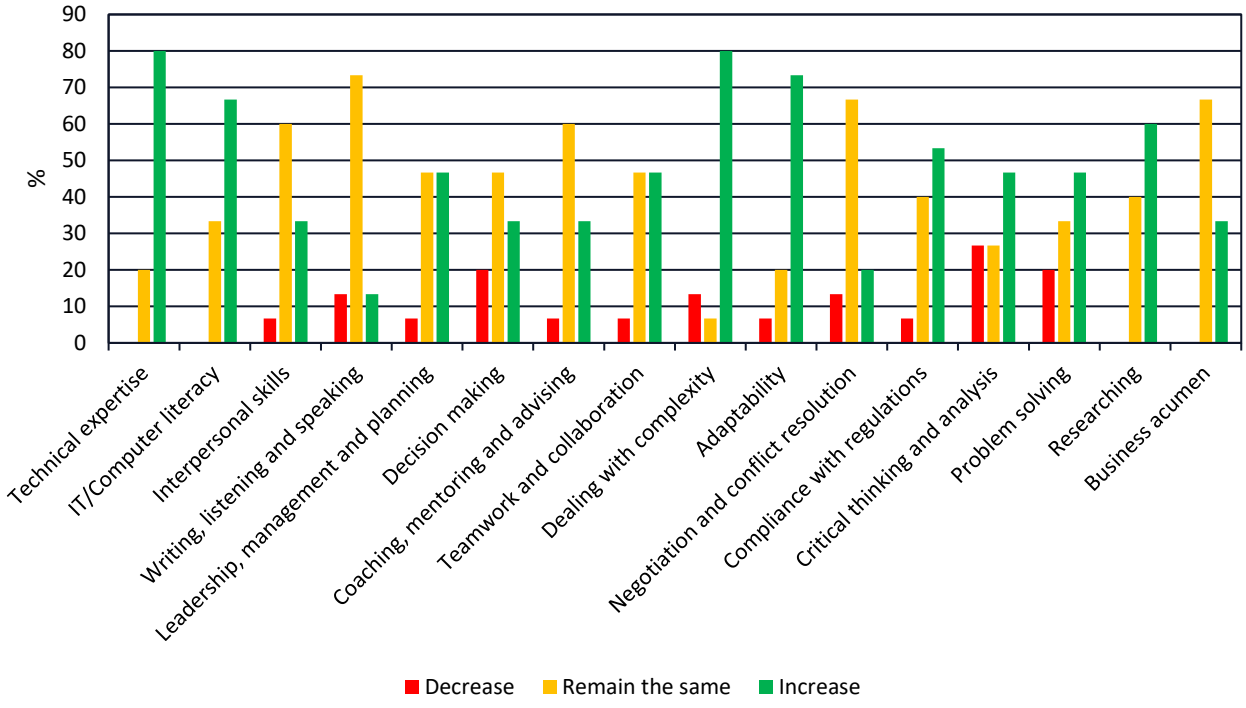


Figure 20 - Change in importance of competency areas in the near future (UAS operations)

2.7 Conclusions

The key conclusions of Section 2 are as follows:

- Several gaps and issues exist in training, and some of these issues are common across multiple categories of VET users.
- Several gaps and challenges exist in the workplace. Some of these gaps and challenges arise from training deficiencies, while others are due to the initial lack of experience of the employee or the unique characteristics of each workplace environment.
- Technology is one of the key drivers of change. Changes will be disruptive in the case of UAS operations while, for other VET users, changes will be incremental.
- Regulation will also have to change. Such changes will partly be necessitated by new technology; however, regulatory changes will still lag behind technological advancements.
- Some jobs will be replaced by automation. However, new jobs will also be created as a by-product of such new technology. This will necessitate the re-skilling and up-skilling of certain job profiles.
- Roles which require human interaction and coordination are less likely to be affected by new technology.
- Some of the most in-demand skills in the future will be adaptability, IT and technology-related skills.

3 Personas: Development of future competency profiles

The aim of task 2 was to develop future competency profiles, namely the Personas, as a follow up of the results of the Skill-UP survey and interviews.

In marketing, Personas are used to represent the characteristics, needs and motivations of the target users of a product. A number of Personas can be developed, each embodying a possible user's type. Each Persona is usually given a name: this is not representing a real person, but the prototype of a single user's type.

In the framework of the Skill-UP project, the Personas represent the target users of future aviation training programmes. In line with this, the aim of the Skill-UP Personas (Task 2.2) is to visualise future aviation job profiles, that will feed the design of appropriate study pathways (Task 2.3). Expected outcomes are:

- To facilitate the efficient and effective adjustment of the workforce to future aviation scenarios
- To assist training providers, employees and employers

Personas are usually presented through a template, including a number of placeholders. Each placeholder embeds one of the user's characteristics that are deemed relevant for the product.

3.1 The Skill-UP Personas development process

Three outputs from three previous tasks of the project were taken as input to design the Skill-UP Personas (Figure 21), as follows:

- Future operational scenarios
- Results from survey and interviews
- Experts' advice as collected in the framework of the Skill-UP national focus groups

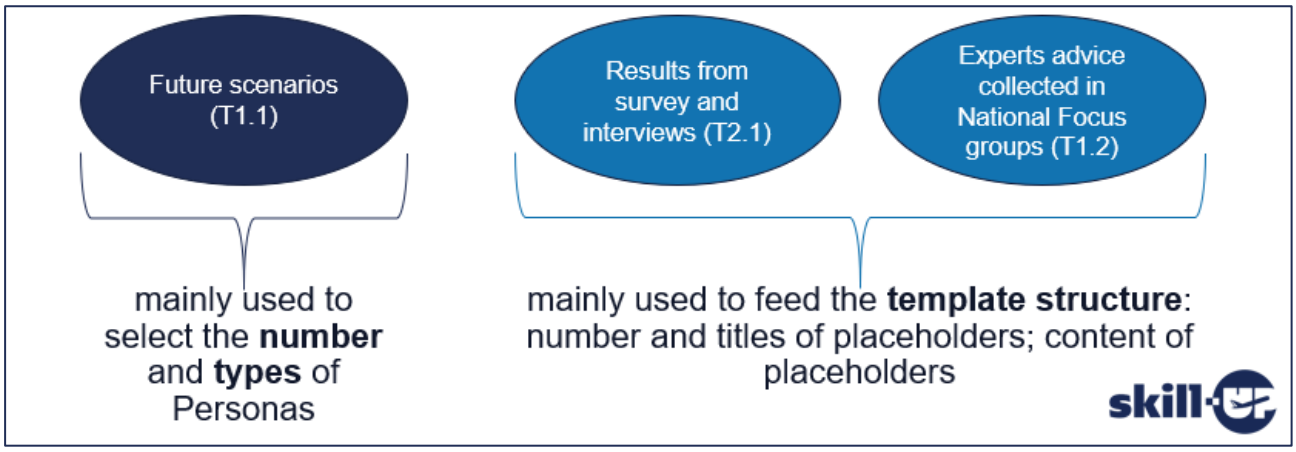


Figure 21- Sources for the Skill-UP Personas development

Four future operational scenarios were developed in the framework of the first task of WP1 (Figure 22), each one addressing a specific aviation environment, respectively ATC, commercial aviation, RPAS and airport. The Remote Tower was chosen as future scenario for the ATC domain; the single pilot operations (SPO) was chosen as future scenario for the commercial aviation; the U-space operations was chosen as future scenario for the RPAS domain; the virtual check-in operations was chosen as future scenario for the airport environment. These scenarios were selected on the basis of desk research and experts' advice. More details on their development will be included in Deliverable D1.1 (Skills, needs and future work scenarios: Air Sector Skills Transformation Map). With reference to the Skill-UP Personas, future

scenarios were mainly used to decide how many Personas would be useful to develop, and what job profiles they would represent.

Figure 22- The 4 Skill-UP future scenarios

The results of the surveys and interviews are the subject of the first part of this document, that extensively presents their design, conduct and outcomes. With reference to the Skill-UP Personas, these results were mainly used to design the structure of the template, namely to decide how many placeholders would be included and what titles and content would have to be included for each of them. The experts' advice collected in the framework of the Skill-UP national focus groups supported these decisions as well. More details on the national focus groups design, conduct and outcomes will be included in the deliverable D1.1 Skills, needs and future work scenarios: Air Sector Skills Transformation Map.

3.2 The structure of the Skill-UP Personas

As anticipated, the future scenarios were taken as a relevant source to decide what job profiles would be represented by means of the Skill-UP Personas. As depicted in Figure 23, the following job profiles were selected:

- Remote tower ATCO and On the Job Training Instructor (OJTI) for the ATC domain
- Single Pilot and Ground Pilot for the Commercial Aviation domain
- Remote pilot for the RPAS domain
- Check-in agent for the airport environment

Figure 23 - Job profiles to be reflected in the Skill-UP Personas

Each job profile was described by means of a new entrant/student (relevant for skilling training programmes) and a professional (relevant for reskilling and/or upskilling training programmes) (Figure 24). Two exceptions are:

- The remote tower ATCO job profile, which also included a Persona representing the on-the-job trainer;
- The Remote Pilot job profile, including two professionals, respectively addressing different categories of operations ("open" and "specific").

Note: The 'On the job trainer' for the remote tower ATCO job profile was limited to the 'professional' persona only, since it is assumed that 'new entrants' will not be assigned to such a training role. Hence the 'On the job trainer' will only be a 'professional' with former ATC experience.

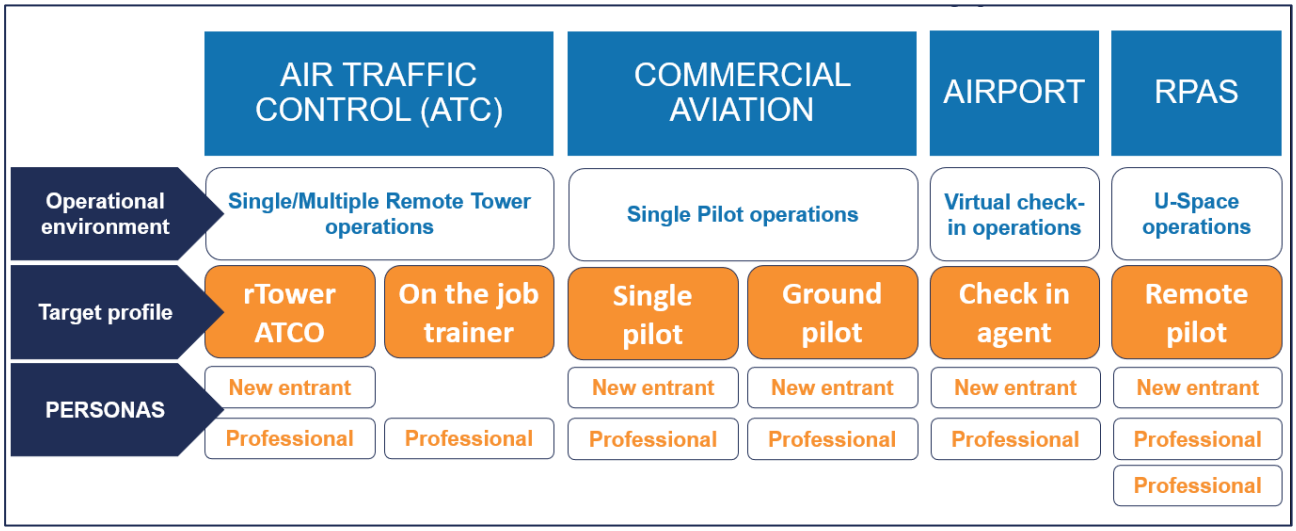


Figure 24 - The structure of the Skill-UP Personas

A total of 12 Skill-UP Personas was produced. Figure 25 details the list of the Skill-UP Personas, showing, for each Skill-UP Persona, the reference operational environment and the impact on training.

THE SKILL-UP PERSONAS

Operational environment	PERSONA ID	THE SKILL-UP PERSONAS	Impact on training
Single/Multiple rTower operations	PERSONA #1	**New entrant rTower ATCO**	Skilling
	PERSONA #2	**Professional Tower ATCO** (who has to become rTower controller)	Reskilling of a professional Tower ATCO
	PERSONA #3	**On the job rTower trainer**	Upskilling of a professional trainer
Single pilot operations	PERSONA #4	**New entrant single pilot**	Skilling
	PERSONA #5	**Professional commercial pilot** (who has to become single pilot onboard)	Reskilling of a professional pilot
	PERSONA #6	**New entrant ground pilot**	Skilling
	PERSONA #7	**Professional commercial pilot** (who has to become ground pilot)	Reskilling of a professional pilot
Virtual check-in operations	PERSONA #8	**New entrant check-in agent**	Skilling
	PERSONA #9	**Professional check-in agent**	Upskilling of a professional check-in agent
U-Space operations	PERSONA #10	**New entrant remote pilot**	Skilling
	PERSONA #11	**Professional Pilot on Open Category** (who is to become pilot in specific/certified category)	Upskilling up a professional remote pilot
	PERSONA #12	**Professional remote pilot in the specific category** (who is to become pilot of optionally piloted aircraft/remotely piloted air taxis)	Reskilling of a professional remote pilot

Figure 25 - The list of Skill-UP Personas

3.3 The template for the Skill-UP Personas

As anticipated, in Skill-UP the Personas represent the target users of the future aviation VET training programmes. Thus, they have been designed with the purpose of describing the competences (knowledge, skills and attitudes) needed to undertake the essential tasks in the future operational scenarios and related training needs.

The structure of the Skill-UP Personas' template (Figure 26) has been designed accordingly. In line with this, it includes the following placeholders:

- Name, age and occupation
- Picture
- Motivation
- Personality traits
- Bio
- Background and education
- (Current) role and tasks
- Gaps and challenges in the (new) workplace
- Changes in roles and responsibilities
- Expected key competences

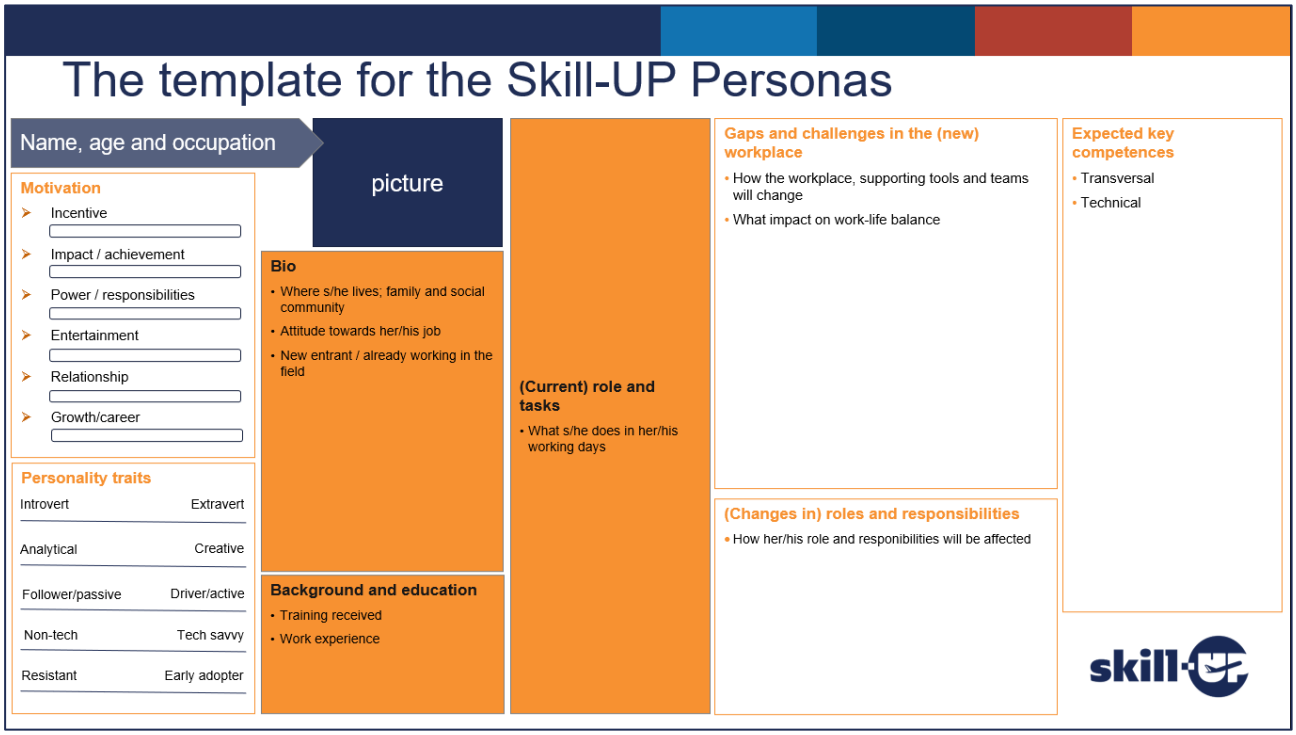


Figure 26 - The template for the Skill-UP Personas

As it is possible to see in Figure 26, the Skill-UP Personas template recalls some of the relevant sections of the Skill-UP survey and interviews.

3.4 The Skill-UP Personas

This section presents the consolidated Skill-UP Personas, clustered by the aviation domain they are addressing. Each Persona has been given a fake name, which does not correspond to a real person, but rather indicates a single prototype of aviation training user.

3.4.1 ATC Personas

Three Personas for the Air Traffic Control (ATC) domain, with reference to the remote tower operational environment, were produced, as follows:

- Patricia, a new entrant remote tower controller
- Bill, a professional OJTI, to be upskilled into remote tower OJTI
- Mary, a professional tower ATCO, to be reskilled into remote tower ATCO

The Patricia ATC Persona (Figure 27) 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 basic use of the remote tower systems, as for the technical skills, and with service orientation, teamwork and decision making among the transversal skills.

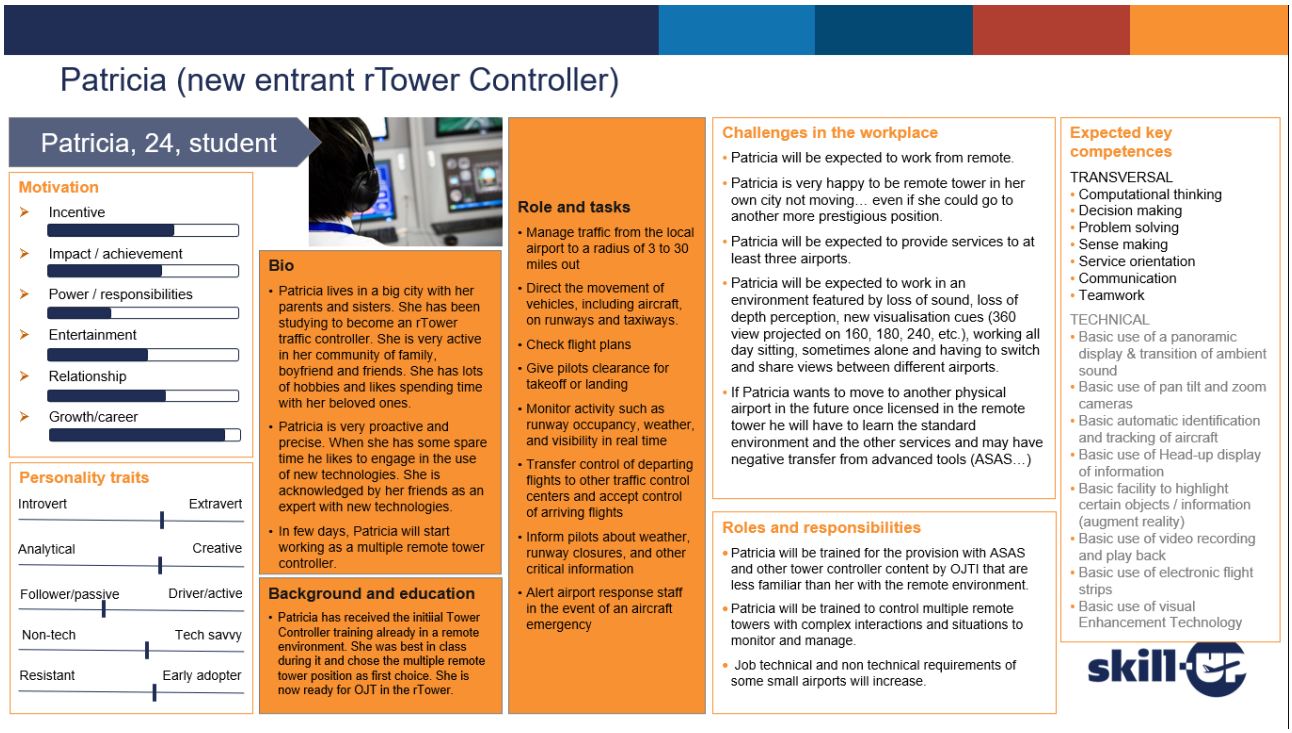


Figure 27 – The Patricia ATC Persona

The Bill ATC Persona (Figure 28) 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 in another city in order to start working as a remote tower controller and OJTI in a multiple remote tower. Bill was designed as 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 into a highly digitalised environment. Moreover, Bill was designed as person who is not that happy to be relocated in 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 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.

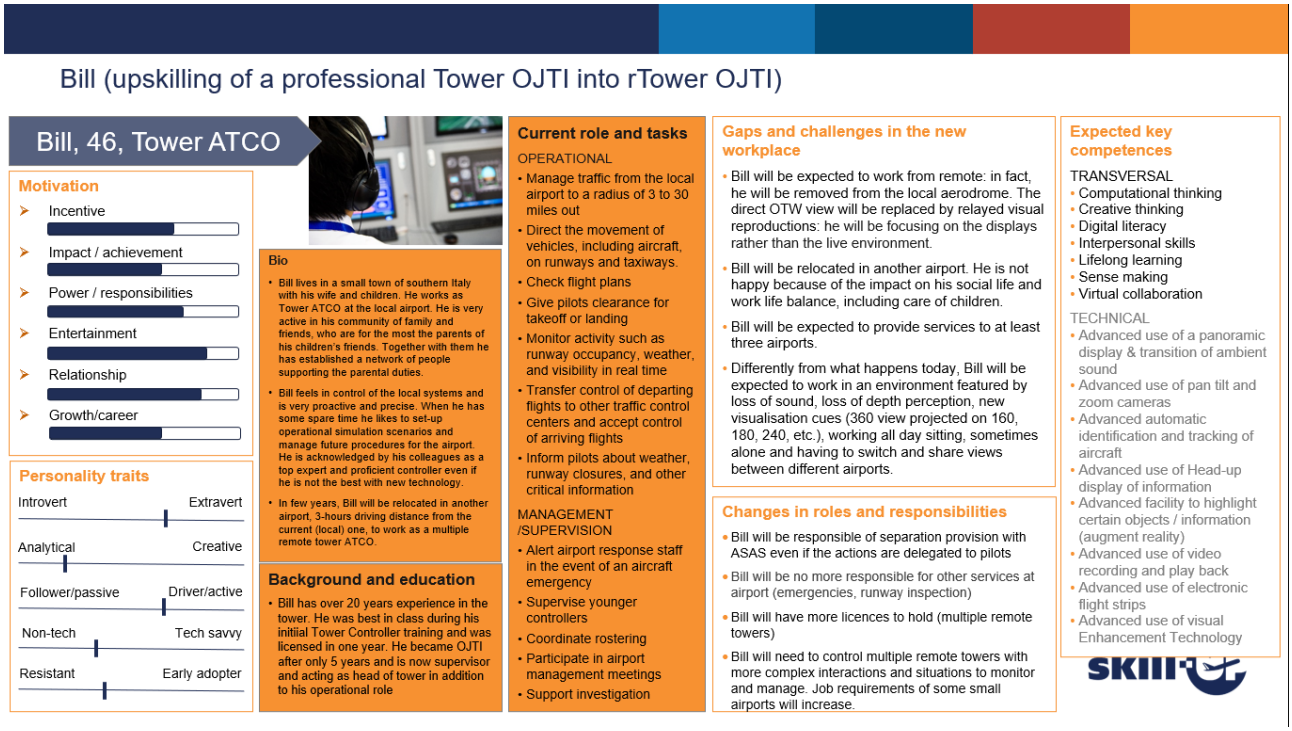


Figure 28 – The Bill ATC Persona

The Mary ATC Persona (Figure 29) 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 in 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 in 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 digitalised 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 programmes.

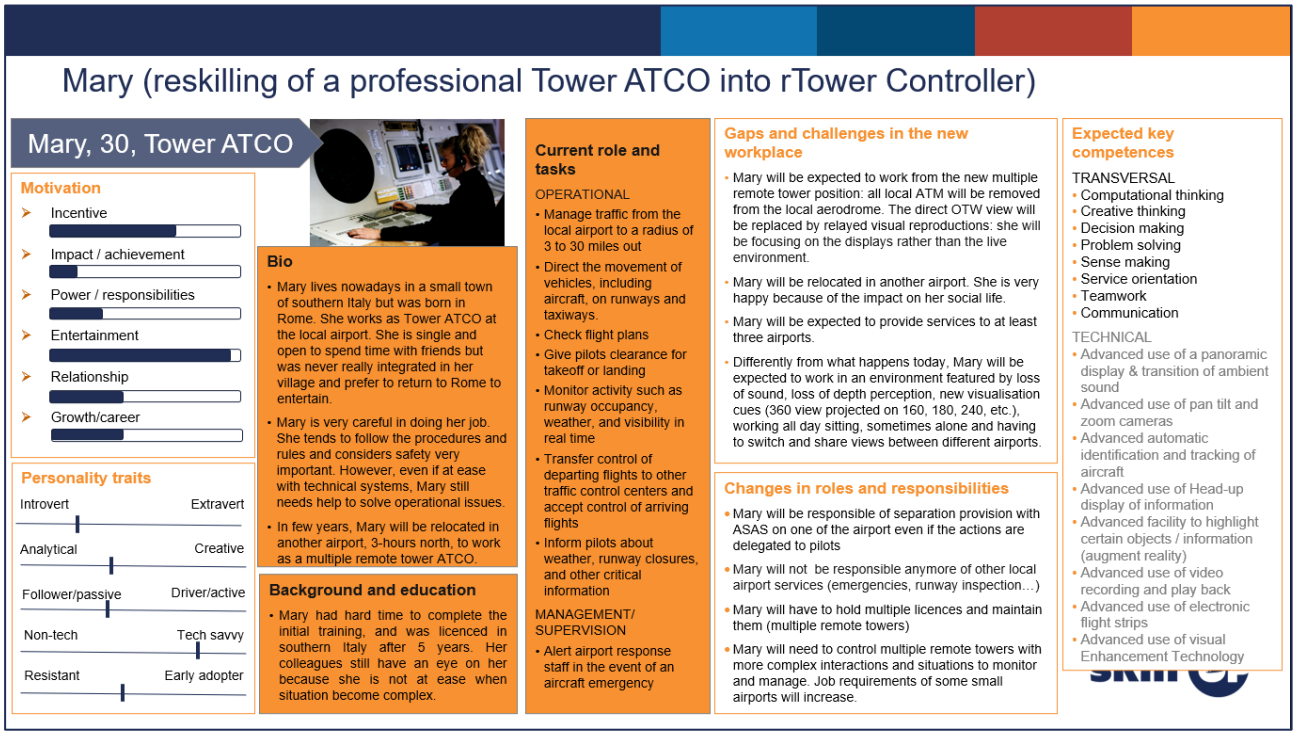


Figure 29 – The Mary ATC Persona

3.4.2 Commercial Aviation Personas

Four Personas for the Commercial Aviation sector (CA), with reference to the Single Pilot Operations, were designed, as follows:

- Sara, a new entrant single pilot
- Irina, a professional pilot to be reskilled into single pilot onboard
- Paul, a new entrant ground pilot
- Roberto, a senior professional pilot to be reskilled into ground pilot

The Sara CA Persona (Figure 30) was developed to represent the professional profile of a new entrant single pilot, namely a young pilot who has a short experience in business aviation. She is qualified on a jet aircraft that is certified as a single pilot aircraft. Thus, she has already been trained to fly as a single pilot. However, in business aviation this aircraft is mainly used as a multijet. Therefore, Sara's experience is mostly based on multiple crew piloting. Sara was imagined as an early adopter of new technologies and very keen on discovering new systems and applications. Her training needs are expected to get used to the change in activities due to the increase of the monitoring activities, especially the monitoring of new and complex automated systems. Hence, she will need to have several competencies around automation management: general automation management (being aware of the risks of complacency, over-reliance on automated systems…), situation awareness of the whole system including one-self, computational thinking in order to better understand how an automated system is functioning and digital literacy. In addition, she will need to have specific competencies regarding the automated systems that will be effectively used in the new type of aircraft she will pilot. She will also need to train her manual flying skills in order to counter the side effect of the increase of automation and to be able to fly the aircraft manually in case of automation failure. Communication skills will also need to be trained as she will be likely to have to communicate efficiently with the ground pilot. Finally, in order to have the more available resources to monitor the systems, she will need to be able to perform other activities as much as possible in a skill-behaviour mode, i.e based on automated cognitive processes that require less selective attention and cognitive resources. In particular, check-lists and procedures will need to be performed in that mode.

Figure 30 - The Sara CA Persona

The Irina CA Persona (Figure 31) was developed to represent the profile of a professional pilot, who has to be reskilled into a single pilot onboard. Irina was imagined as an experienced captain of a major airline. Thus, she has been trained and has built her experience on flying an aircraft with a multiple crew. She is used to a clearcut separation between the pilot flying activities and the pilot monitoring activities. She is also used to discuss all the important decisions with the other flight crew member and to cross-check all the actions required by the procedures and the check-lists. Her training needs are expected to deal with knowledge about automated systems, both general (risks of complacency, over-reliance on automation, but also the need to have a minimum trust in automation) and specific (new automated systems related to the single pilot aircraft). She will need to be trained on having a good situation awareness and specifically on monitoring her self-situation awareness. Indeed, safety will rely even more strongly on her self-knowledge of her mental state and her level of situation awareness. Finally, communication skills will also need to be trained as she will be likely to have to communicate efficiently with the ground pilot.

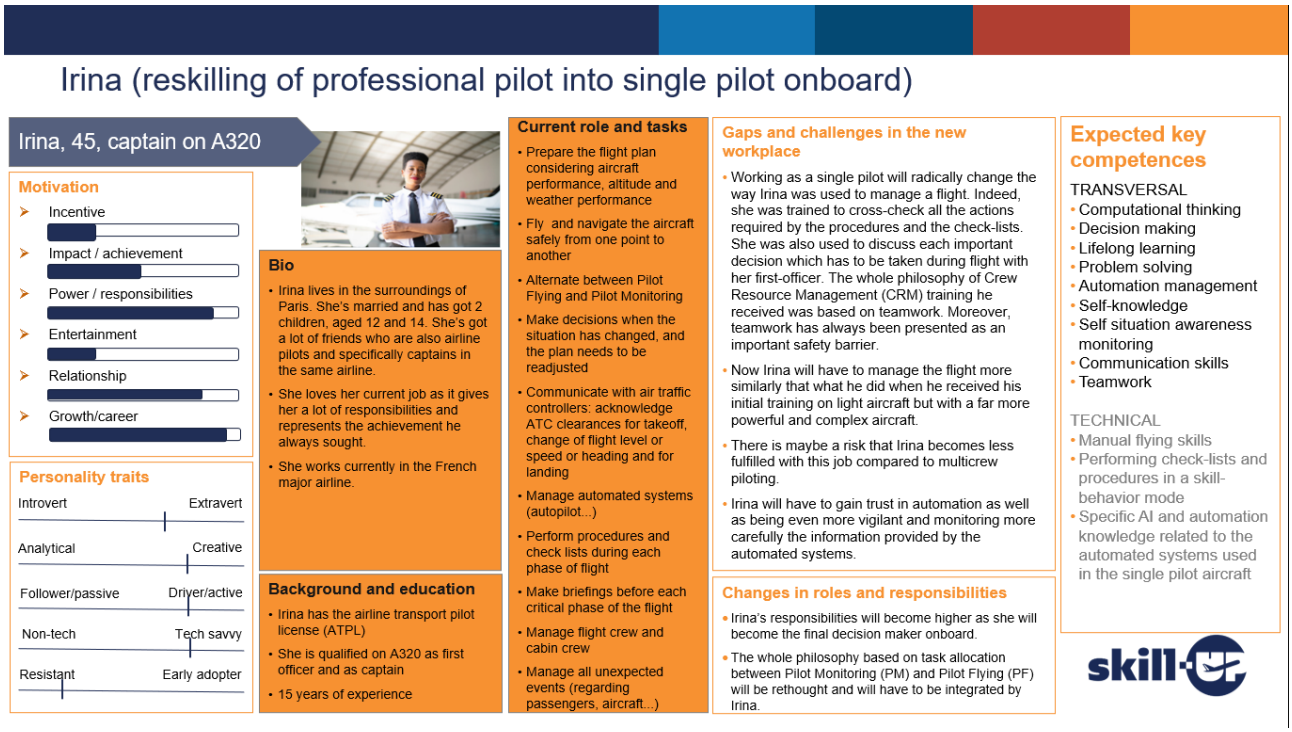


Figure 31 - The Irina CA Persona

The Paul CA Persona (Figure 32) was developed to represent the profile of a junior commercial pilot who is in the initial stage of his flying career and who will need to be trained as a ground pilot. Paul is an outgoing individual who became a pilot because of the sense of adventure that this job offers and therefore the ground pilot role will be less exciting to him, but he understands that it is a necessary step on his journey to become a single (onboard) pilot. Paul is very comfortable with new technology and will therefore not find it difficult to learn how to use the various automation systems which will be available to him as a ground pilot. On the other hand, Paul will find it more challenging to work on his own and to build a mental picture of the state of the aircraft which he will be monitoring remotely. This is because Paul is used to working with another pilot in the cockpit and, in his ground pilot role, he will be deprived of several cues which are available to the onboard pilot. Additionally, Paul may have to monitor different aircraft at the same time and hand over to another ground pilot at the end of his shift. Paul's technical training needs are expected to include the use of IT tools and automation related to his ground pilot role, including automation to take over an aircraft in the event of onboard pilot incapacitation. On the other hand, Paul's transversal training needs will include multi-tasking, time management, communication and independent decision making.

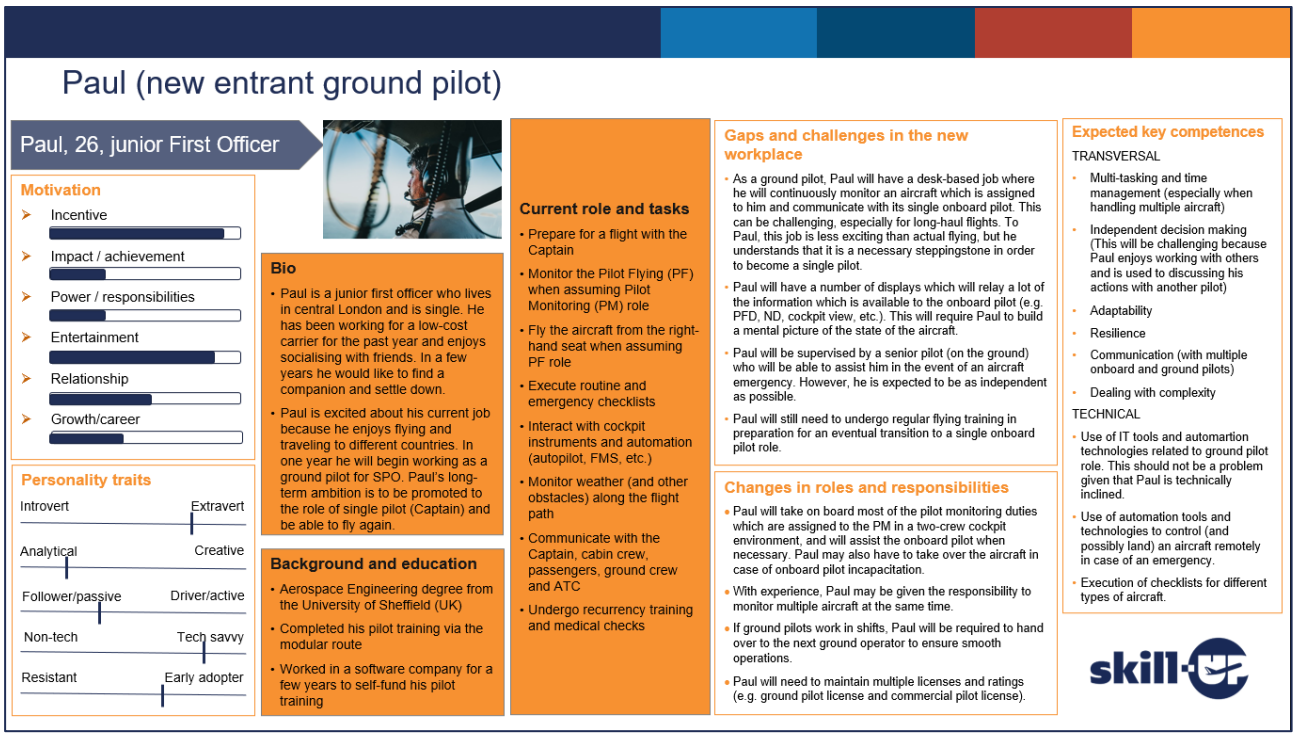


Figure 32 - The Paul CA Persona

The Roberto CA Persona (Figure 33) was developed to represent the profile of a senior professional pilot who has to be reskilled for the role of a ground pilot. Roberto was thought of as being an experienced pilot who already had enough flying experience to be considered for command upgrade, but had suffered some setbacks because of company restructuring. The role of the ground pilot may therefore be felt as yet another setback for Roberto, and his motivation may be affected. He would also have to adjust to an environment in which some of the sensory cues he would have had on board an aircraft would no longer be available directly, and would have to rely either on information supplied by the single pilot on board or on data from multiple sensors on the aircraft. This new environment may thus pose an additional challenge in maintaining a high level of situational awareness. Since Roberto would lose the direct interaction with the Captain, which he was used to in the traditional two-person cockpit, he would have to adjust to a new and different team working environment. Roberto is thought of as having to spend some days away from home because of his current role, and thus may view the ground pilot role as an opportunity for improving his work-life balance. Roberto's training needs are expected to deal with IT and computer skills, software proficiency and management of automation systems from a technical competencies point of view. The new environment means that, amongst the transversal competencies, the top training needs will be in situational awareness and sensemaking, workload management and multitasking, decision making, communication and teamworking.

Figure 33 - The Roberto CA Persona

3.4.3 RPAS Personas

Three Personas for the RPAS domain, with reference to the U-space operational environment, were produced, as follows:

- Mary Jane, a new entrant remote pilot in the Open category;
- Marco, a professional remote pilot in the Open category, to be upskilled for the Specific category;
- Oscar, a professional remote pilot to be reskilled to fly optionally piloted vehicles and remotely pilot air taxis within the U-space;

The Mary Jane RPAS Persona (Figure 34) was created to represent a new entrant remote pilot who will be trained as a pilot in the Open category. She represents many hundreds of teenagers who have recently finished their high-school and are looking for some acknowledgment and easy access to a salary by doing something that they really love – flying their drones, editing the videos, and posting them online. She lives in an EU city, with easy access to mainstream media, information, gadgets and technology. Ever since she was given a commercial camera drone, she has not stopped upgrading it, and adding extra features and tunes to her videos. She finds this type of "aviation" as an attractive alternative to common/conservative hobbies/jobs activities and wants to pursue an initial career as a filmmaker and air photographer. She will face a significant change in responsibility, shifting from drone flying for her own interests, to flying commercially for other clients – this will challenge her in the sense that she will experience stress, will have to manage expectations (her own, the company and the clients'), highly demanding goals and quality of the final product. Although, being used to autodidactic learning, she is to be taught new competences and skills, from which it is worth highlighting the following: good orientation in 3D space, adaptability to changing operations and weather, humility, coping with frustration of failing, analytical thinking and managing a considerable amount of information; on the technical side, she has to be skilled to having good eye-hand coordination, understanding technical drawings, environmental protection, aerodynamics and performance of multi-rotors, automatic flight, data links and telecommunication, air law and flight procedures.

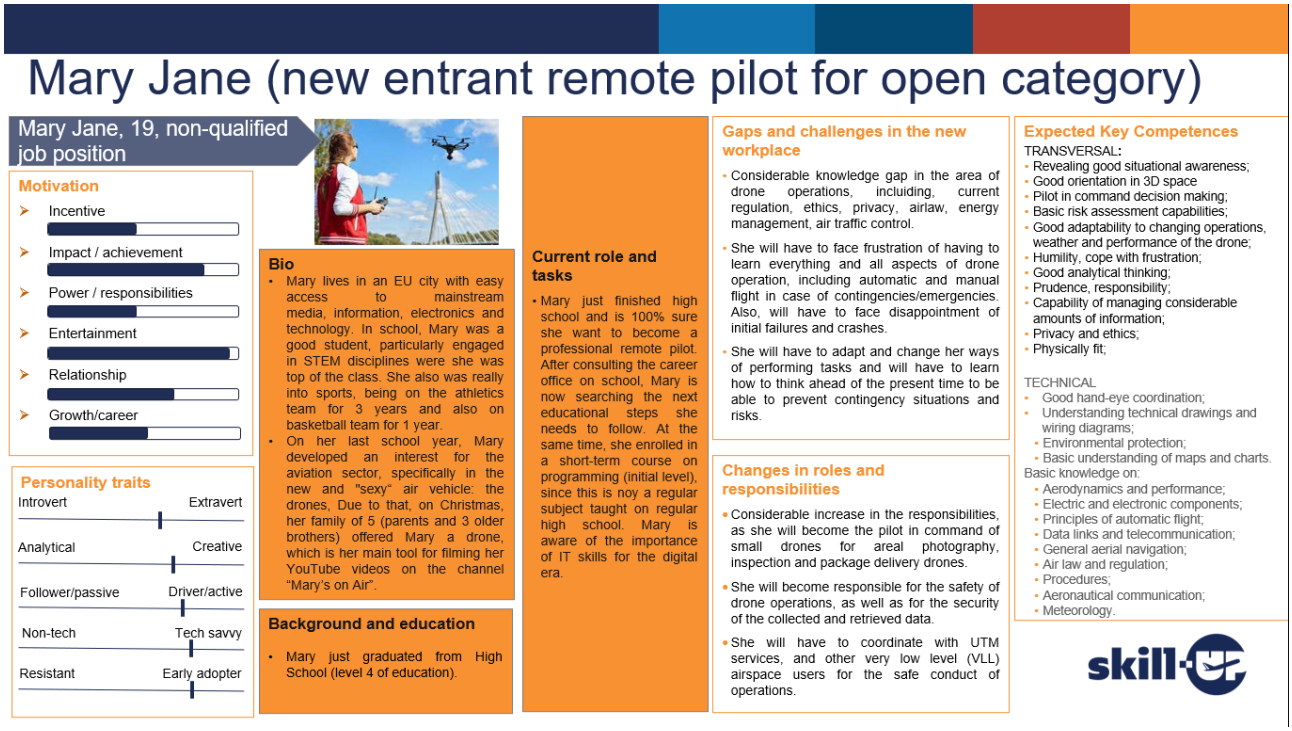


Figure 34 – The Mary Jane RPAS Persona

The Marco RPAS Persona was created to represent a professional remote pilot in the Open category, working for a company that provides services to the drone industry, for imagery and inspection of structures, who is to be upskilled for operation of drones in the Specific category. Marco reflect the enthusiasts stepped into drone flying a few years ago, gathering considerable knowledge on the operation of complex multirotors in the Open category. He got his knowledge from self-learning, trial and error, as well as company and regulator promoted courses. Marco represents all young tech savvy persons who have a technical/engineering background and have decided to take the leap into drone flying, first by building their drones, flying them (and crashing several times, of course). Originally from a small village, he moved to a major city to pursue his EU level 5 degree on a technical subject. During his course he started to buy drones in parts, build them and test-fly them in an open field. As an introvert geeky-like person, he would rather be alone working on his personal projects, than enjoying any social contact with friends. With a strong connection to his family, he loved returning to his village on long weekends and holidays, as he could practice new skills and test new upgrades on his drones. Currently with five-year experience in drone flying in the Open category, for a major player in the field of aerial imagery and structure inspection, he needs to be trained as a remote pilot in the Specific category. He will be facing considerable changes in his roles and tasks, shifting from outdoor eye-on-drone, i.e., visual line-of-sight (VLOS) remote pilot used to fly for 25 minutes at a time, to beyond line-of-sight (BVLOS) remote pilot who will be commanding a mission that may last up to 6 hours. Additionally, he will change from a single pilot operation to a multi-crew environment, encapsulated inside a ground control station with other subsystem operators. Marco has to be upskilled and trained, using high end flight simulators. As a result, his soft/transversal competences will have to be upskilled to be able to work in a multi-crew environment, cope with frustration, trusting onboard sensors and information, expand his multi-tasking abilities, and a considerable increment in his communication skills, both for team coordination, briefing and debriefing, as well as for aeronautical communication with UTM. On a technical side, he will have to gain new competences on U-space procedures and regulation, air law, airspace management and flight planning, human factors, aerodynamics of fixed wing aircraft, meteorology, broad-band long range datalinks, contingency and emergency procedures,

Figure 35 – The Marco RPAS Persona

The Oscar RPAS Persona was created to represent a highly probable future major need that is to have pilots that are able to fly an aircraft remotely, via tele-operation, as well as be a part of new projects that aim at converting certified aircraft into optionally piloted/automatic aircraft, such as air taxis, in the urban mobility scenario. Oscar, who turned 38, is married and has two children. He moved to the city at the age of 19 to enroll in a technical/engineering course. He loves his job as a remote pilot in the Specific category, where he is in charge of maiden flights, persistent operations, integration and testing of new payloads. Additionally, he is a remote pilot instructor, and has a civil personal pilot license. As an aviation enthusiast, he loves fixed wing aircraft and has gathered considerable amount of aviation relics in his studio tool-shop, in his house in the suburbs of the capital. Being recognized as an experienced remote pilot and team leader with good communication skills, Oscar will have to step out of his comfort zone to be able to meet the challenge of being reskilled to become a remote pilot and onboard pilot of optionally piloted single engine aircraft. As a result, he will have to further deepen his competences to be more alert to retain and increase his situational awareness, train procedures and analytical thinking for fast(er) and safe(r) decision making capabilities. At an age of 38, he will have to adapt to new responsibilities and roles, as these "new" aircraft that he will be commanding are to be flown with people onboard – these pose a considerable challenge, where he will be forced to learn more and have a more profound sense of risk, its assessment and proper mitigation. On the technical side, he will have to deepen his knowledge on UTM, ATM and flight planning, system automation and respective disengaging of the automatic systems in case of failure to manually fly the aircraft, artificial intelligence on the cockpit, as well as operational and human limitations.

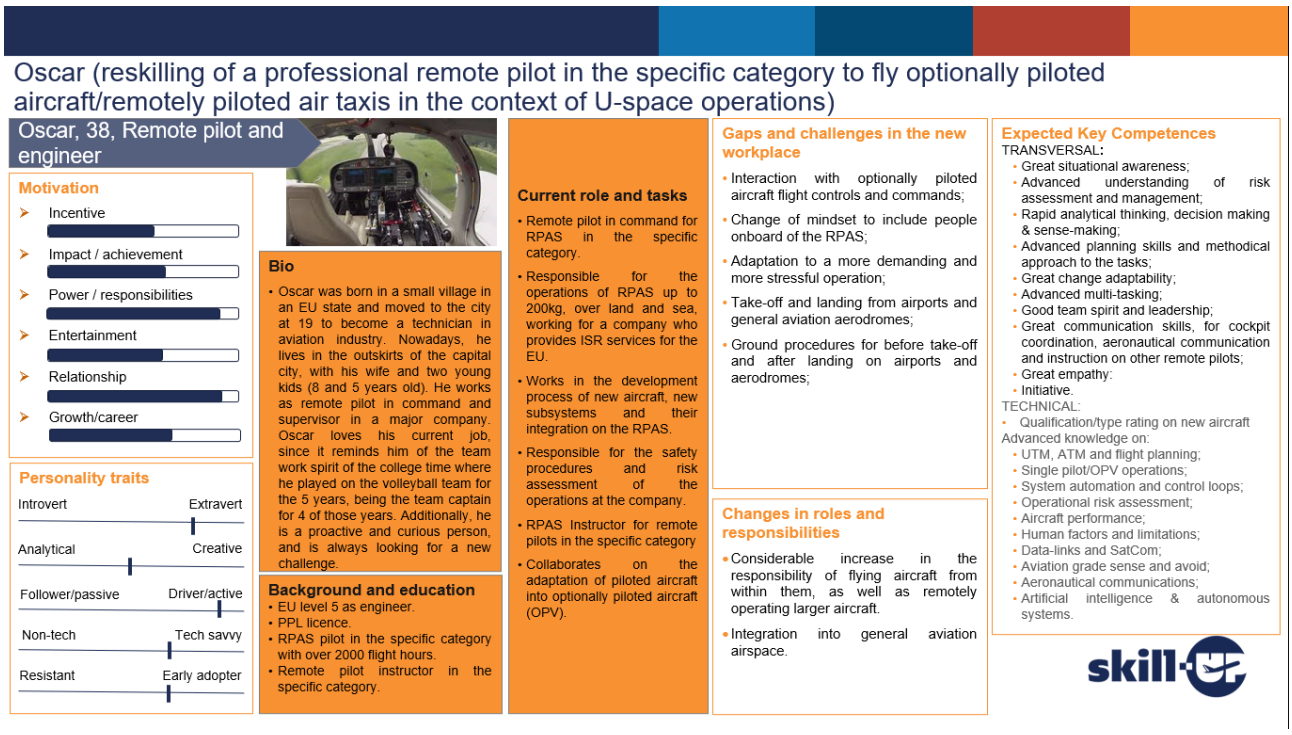


Figure 36 – The Oscar RPAS Persona

3.4.4 Airport Personas

Two Personas for the airport environment domain, with reference to the virtual check-in operations, were produced, as follows:

- Gözde, a new entrant virtual check-in agent
- Ipek, a professional check-in agent, to be reskilled into a virtual check-in agent

The Gözde airport Persona (Figure 37) was developed to represent the new entrance virtual check-in agent profile of airport-ground handling business. Gözde was born in Antalya in the Mediterranean regions of Turkey. In Antalya, life is very enjoyable and weather conditions always keep people up. It is sunny and warm almost 9 months of the year. When she was a little child, Gözde was living very close to the airport. She was watching aircrafts all nights and trying to understand the differences between stars and aircraft. She could not imagine how the plane in the sky does. When she finished high school, she decided to work at the airport. To achieve her dreams she looked for departments which were suitable for her background and personality traits. As a result of her research, she thought that the passenger services department might be suitable. This job requires people to easily adapt, have strong communication, and are familiar to technological tools and systems. Gözde followed the recruitment and then applied for a job to Havas Ground Handling. The first challenge of obtaining an occupation was to pass written and interview exams. She achieved all exams and started to work 1 year ago. At the beginning of her job, she faced very different and new learning things. The training process was disciplinary and every time was full of new information. On-the-job training was very efficient. Within a year, Gözde learned about the civil aviation general rules, aviation terminology, aircraft passenger cabins, airport terminal systems, check-in systems, boarding process, teamwork, and being faster and more active in her business. After an orientation process Gözde gathered work experience in one year time. She planned to develop herself and her areas of responsibilities in the coming years. She gained knowledge about the aviation business getting more technologic skills by the time. She thought always "if you believe in full energy and enjoyable memories at work, you are in the right place in passenger services."

Figure 37 – The Gözde airport Persona

The Ipek airport Persona (Figure 38) was created to represent the professional virtual check-in agent profile of airport-ground handling business. She has been working in the airport ground handling company-passenger services department for six years. Six years ago, Ipek learned that there was a job opportunity at the airport during a computer course which she attended to increase her personal competence. She applied to exam, passed the exams, and was hired as check-in agent. This job was highly interesting and very convenient with her personality. Simply because she likes interactive communication with people, problem solving and new technologic systems. During and after the training process, she understood that job is not only ticket transactions, it is also needed carefulness, patient and smiling all the time.

During three years she improved herself on her job and gained experience for management skills. By the time she has attended refresher training on many subjects regarding check-in processes. She learned new rules, new check-in systems, different practices in every airlines regulations, those kept her always dynamic and made ready for promotion on her career.

She is currently working as a boarding responsible person. She manages a team with 15 members. This is the area where the passengers' stress is at the lowest level. This place is very suitable for learning new things and increasing coordination and leadership skills. Her next goal is to become an instructor and team chief. She knows as long as improve herself for leadership, new technologies, aviation regulations and customer oriented services will be helpful for her future career plan.

Lifelong learning is very important in the aviation industry, especially human relations and solution-oriented approach play a very significant role.

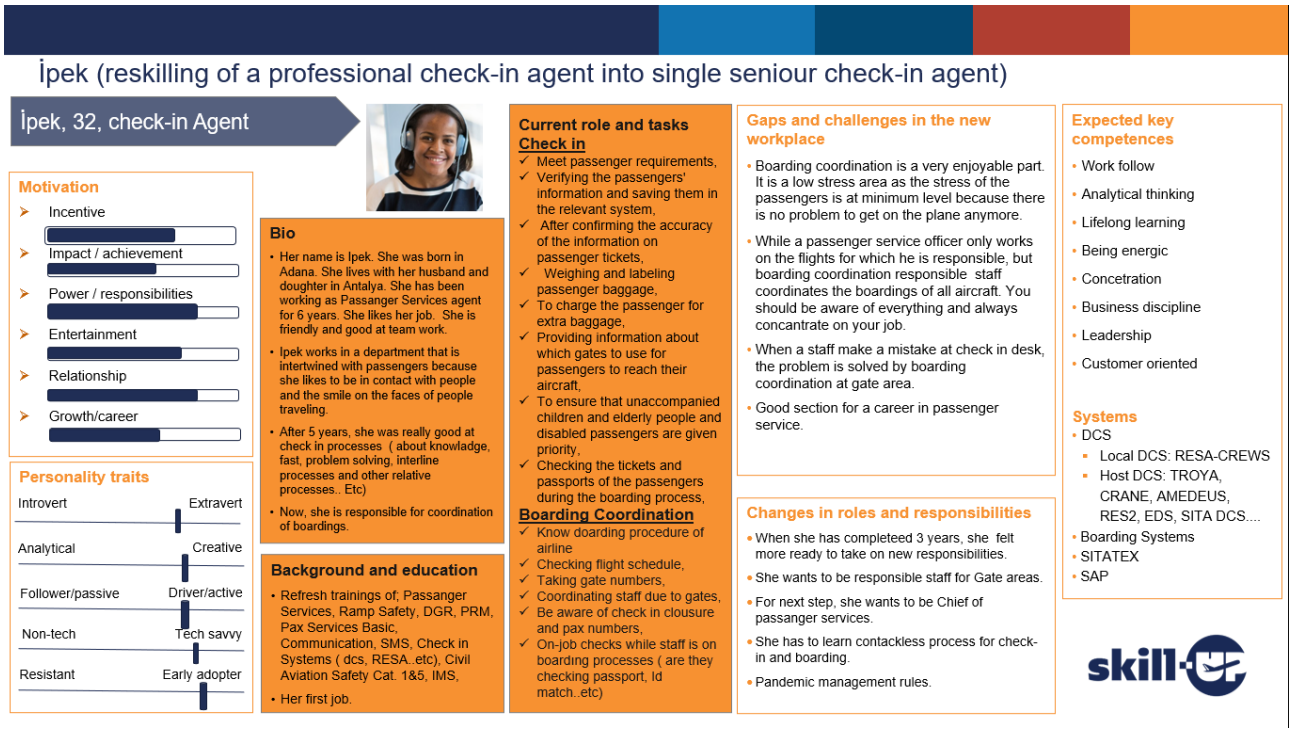


Figure 38 – The İpek, airport Persona

4 Next steps

The Skill-UP Personas are the main output of the research activities conducted through the online survey and expert's interviews.

The Skill-UP Personas were developed to implement those results into future aviation job profiles. Twelve Personas were designed with the purpose of describing the competences (knowledge, skills and attitudes) needed to undertake the essential tasks in the future operational scenarios and related training needs. The following job profiles were selected:

- Remote tower ATCO and On the Job Training Instructor (OJTI) for the ATC domain
- Single Pilot and Ground Pilot for the Commercial Aviation domain
- Remote pilot for the RPAS domain
- Check-in agent for the airport environment

Each job profile was described by means of a new entrant/student (relevant for skilling training programmes) and a professional (relevant for reskilling and/or upskilling training programmes). Two exceptions are:

- The remote tower ATCO job profile, which also included a Persona representing the on-the-job trainer;
- The Remote Pilot job profile, including two professionals, respectively addressing different categories of operations ("open" and "specific").

A total of 12 Skill-UP Personas was produced. Figure 25 details the list of the Skill-UP Personas, showing, for each Skill-UP Persona, the reference operational environment and the impact on training.

The Personas will be used to feed the next tasks of the project.

In fact, since they include a section on expected competences, they will support the development of the Air Sector Skills Transformation Map (task 1.4), which will work as a tool to visualize the gaps between current and future competences needed by the aviation workforce.

The Skill-UP Personas will be also used to feed the development of the study pathways (task 2.3), and, based on them, also of the training programmes (in WP3) and the VET training assessment portfolio (in WP4).

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

To achieve this, Personas will be graphically implemented, in compliance with the graphical representations of future aviation scenarios.

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