From education and training to the workplace: Gaps and challenges in aviation

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ABSTRACT

The aviation sector is constantly evolving, and it is necessary to keep training and education methods and programmes aligned with the needs of the workplace. This paper presents and discusses the results of a multinational study which was carried with 204 participants to analyse the transition from education and training to the workplace. The study was carried out by means of an online survey and structured interviews and focused on four groups of Vocational Education and Training users (flight crew, air traffic controllers, airport operators and Unmanned Aircraft System operators) and three target groups (employees, employers and external training providers). The results of the study highlight gaps in training and education; frequently encountered challenges in the workplace; changes which are expected to occur in the future workplace; and the impact of those changes on jobs and roles. These results will be used to identify new job profiles and to design study pathways, training programmes and assessment tools for the future aviation workforce.

KEYWORDS

Aviation, education and training, future workplace

Introduction

The nature of work is constantly changing, and the aviation sector is no exception. In order to cope with these changes, it is necessary to equip workers with the skills and competences required to adapt to their workplace environment. This includes the upskilling and reskilling of workers. A recent survey found that private-sector organisations are increasingly considering investments in retraining and upskilling of existing workers as an urgent business priority (Illanes et al., 2018).

Several European research projects, such as Mobility4EU and SKILLFUL, have sought to predict what the future workplace will look like in a bid to understand what skills and competences will be required by future workers. The Mobility4EU project developed a vision for the European transport system in 2030, as well as an action plan to implement that vision. On the other hand, SKILLFUL identified the skills and competences that will be required by the transport workforce at various future milestones (up to 2050) and defined training methods and tools to meet those requirements.

This paper presents and discusses the results of a study which was carried within the framework of the Skill-UP research project (Skill-UP, 2020. The study, which was conducted by means of an online survey and structured interviews, examined the transition from education and training to the

workplace in the context of the aviation sector (both now and in the near future) and focussed on four main groups of Vocational Education and Training (VET) users, namely: flight crew, Air Traffic Control Officers (ATCOs), airport operators, and Unmanned Aircraft System (UAS) operators. The study also considered three target groups within each group of VET users: employees (new entrants and experienced professionals), employers and external training providers.

Method

Survey and interview design

Google Forms was used as the platform to design and conduct the survey. The survey consisted primarily of Likert scale rating questions; however, some open-ended questions were also included. The first section of the survey focussed on the participants' background (and was common to all participants) whereas the second section was tailored to each target group. The survey was designed to take approximately 15 minutes to complete and was disseminated to various stakeholders via email and social media channels.

The structured interviews were conducted with participants from each target group, with a different set of questions for each group. Participants within each target group were selected in such a way that the four groups of VET users were represented. The interview questions were mostly open-ended; however, some closed-ended questions, using rating scales, were also used. Each interview lasted approximately one hour.

In order to reach a wide audience, the survey – originally designed in English – was translated into Italian, Portuguese and Turkish. Similarly, the interviews were conducted in four different languages. The survey and interviews were carried out over a period of approximately six weeks and participation was completely voluntary.

Participant profile

The nationality and age of the survey and interview participants is shown in Figure 1. 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% male, 25% female and 1% other. The number of participants in each target group and in each group of VET users is shown in Table 1.

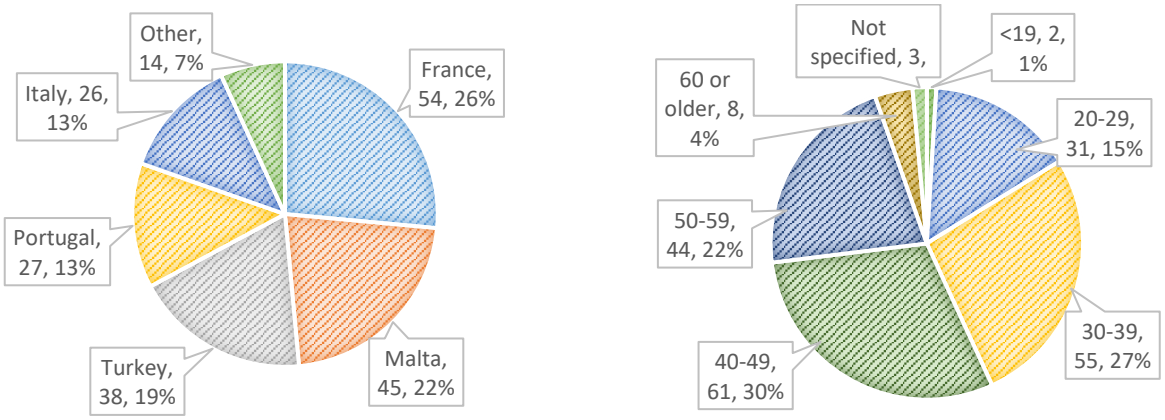

Figure 1: Participant nationality distribution (left) and age distribution (right)

Table 1: Number of participants in each category

VET users	Target group			Total
	Employee	Employer	External training provider	
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**

Findings

Training gaps and issues

The survey participants were asked whether they followed any training programme prior to employment. Whilst the majority of flight crew and air traffic controllers (95% and 70% respectively) claimed to have followed a training programme, only 52% of those involved in airport operations and 50% of those involved in UAS operations claimed that they did. The participants were also asked to rate the quality of the training which they received prior to employment with respect to several key indicators (Figure *2*). 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* rated lowest. Table 2 highlights the main training gaps and issues identified by each group of VET users.

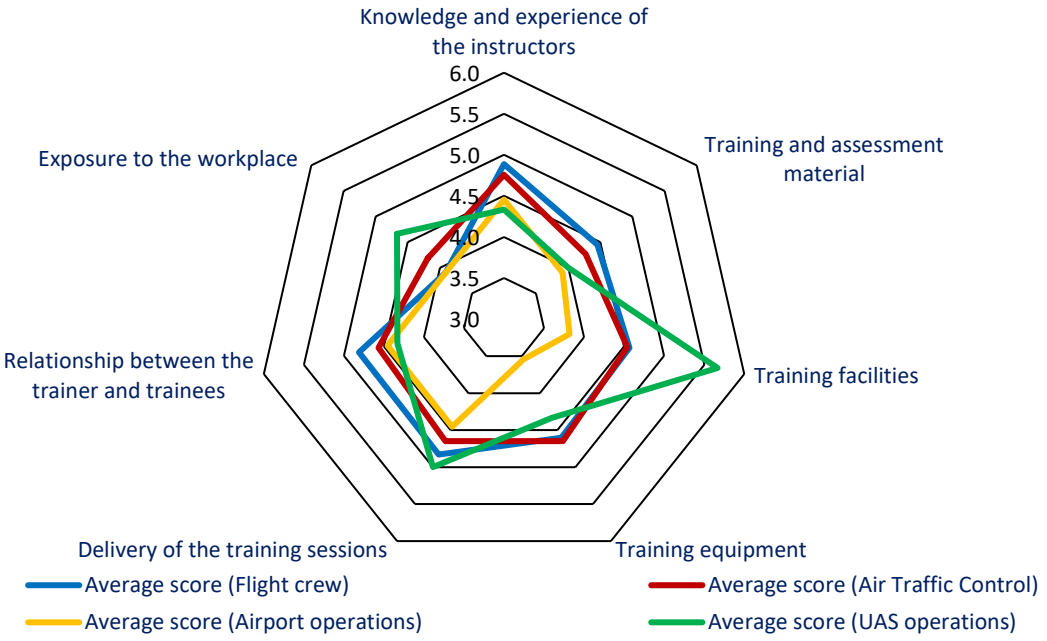

Figure 2: Quality of training

Table 2: Training gaps and issues

VET	Training gaps and issues	
Flight crew	• Human factors training is limited • Training focusses on single pilot skills whereas pilots work in a multi-crew environment • Simulator time is limited • Abnormal scenario training is repetitive/predictable • Training regulations are outdated, prescriptive and restrictive	• Basic flying skills are not given sufficient importance • Flight instructor training is done with another instructor (i.e. no students are involved) • Flight instructors are not necessarily experienced in the industry • Lack of exposure to the workplace • Imbalance between theory and practice
Air Traffic Control	• Human factors training is limited • Training programmes are too prescriptive and repetitive • Training should focus more on problem-solving scenarios • Imbalance between theory and practice • Simulator time is limited and should be more realistic	• Training should focus more on multi-tasking and handover techniques and teamwork • Instructors should be practitioners • Lack of exposure to the workplace • Further harmonisation of training requirements may reduce amount of local training (i.e. by the employer)
Airport operations	• Inadequate training on immigration issues, document checking and control • Inadequate training on handling of passenger complaints/conflicts • Inadequate training on the use of manual procedures in the event of automated system failures	• Lack of training on emergency response and management • Training should focus more on essential tasks and individual deficiencies • More practical training for Aircraft Rescue and Fire Fighting (ARFF) personnel is required
UAS operations	• Limited amount of instructors and of approved training organisations for Remotely Piloted Aircraft Systems (RPAS) • The quality of RPAS training organisations is variable • Training should focus more on safety-related issues besides operational issues • Lack of training of ‘soft’ skills	• Training programmes do not address real-world operations • No adequate and harmonised regulatory guidance exists • Initial training is too focused on technical aspects • Lack of interdisciplinarity in training

Workplace knowledge/skill gaps and challenges

The participants were asked to identify any knowledge/skill gaps and challenges which they experienced in the workplace at the beginning of their job, as well as methods which they used to approach them (Table 3).

Table 3: Workplace knowledge/skill gaps and challenges

VET	Workplace gaps and challenges	
Flight crew	• Limited knowledge of specific aircraft/systems → refer to more experienced colleagues; train in a simulator • Handling of scenarios (e.g. weather patterns) not encountered in training → consult with senior crew members	• Human factor issues (e.g. workload, fatigue) → address issues during debriefing • Logistical challenges • Getting used to geo-political influences and foreign cultures

	• Adapting to a commercial environment • Handling changes in industry policy and company Standard Operating Procedures (SOPs) → refer to manuals; contact support or management	• Assessing training needs of students • Completing flying training according to a tight schedule • Assessing the character and attitude of new pilots
Air Traffic Control	• Limited knowledge of technical systems, vocabulary and acronyms → refer to documentation • Communicating with live traffic • Human factor issues (multitasking, workload, etc.) → control workload e.g. by saying 'standby' to some aircraft • Influence of existing staff on new staff • Resistance to change by experienced controllers • Handling non-routine situations → ask colleagues for assistance; improvise; use common sense	• Differences between training and real-life • Behaving correctly in front of students and teaching very young students or large groups of students → get students involved and point out any misbehaviour • Learning training material before passing it on to students • Technology gap (outdated equipment and un-ergonomic setup) • Lack of interpersonal skills • Assessing new employees
Airport operations	• Learning how to use technical systems on the job → consult with supervisor; refer to training documents • Lack of knowledge of regulations (VISA/immigration requirements, etc.) → ask if in doubt; do own research • Human factor issues (e.g. confronting passengers) → be assertive but explain the situation	• Handling specific airline restrictions, flight cancellations and delays → ask peers for assistance • Finding employees with the right work ethic • Adapting to the fast pace of an airport environment • Communicating in English
UAS operations	• Lack of manual/practical flying skills • Lack of knowledge (software and planning tools, standards, airworthiness, etc.) → read articles, watch videos, refer to manuals	• Executing new activities • Involving people in safety management • Handling practical aspects of the job • Human factor issues (dealing with frustration and failure, etc.)

Foreseen changes in the workplace

The participants were asked to identify changes which are expected to occur in the workplace in the near future (2030 and beyond) and any external factors which can impact the workplace (Table 4).

Table 4: Changes and factors which will impact the workplace in the near future

VET users	Changes and factors	
Flight crew	Technology (automatic take-off, Single Pilot Operations (SPO), etc.) Drones and drone transportation Regulation Contagious diseases	Climate change The global economy Training tools Airline policies Security
Air Traffic Control	Technology (remote towers, assistance systems driven by Artificial Intelligence (AI), etc.)	Contagious diseases Climate change

	Drones/RPAS Urban air mobility Regulation (noise abatement, direct routing, etc.)	The global economy Societal changes Staff shortages Expansion of the airspace Diplomatic relations between countries
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, Unmanned Traffic Management (UTM), etc.) Societal acceptance

Impact of changes on jobs and roles

The participants were asked to state how much they agree with the statement that their jobs will change significantly in the near future, by giving a score from 1 (strongly disagree) to 6 (strongly agree). The overall average score was 4.6, with the highest average score (5.3) given by those involved in UAS operations. The participants were then asked to explain how their jobs and roles would be impacted by foreseen changes in the workplace (Table 5). The participants were also asked whether the importance of different competency areas will change in the future workplace. The top three competency areas which are expected to increase in importance for each group of VET users are given in Table 6.

Table 5: Impact of changes on jobs and roles

VET users	Impact
Flight crew	The role of an airline pilot will continue to change, partly due to automation and AI The pilot's role will become more about managing equipment and people The level of threats caused by human factor issues will decrease Technology and AI will affect how pilot training and assessment are carried out Certain manned flights will become unmanned (coastal surveillance, inspections, etc.) In a single pilot cockpit, the pilot will be more isolated and will need to be more self-reliant
Air Traffic Control	ATCOs will transition from a purely operational role to one of managing complex systems Controllers will need to accept new technology, learn about it and learn how to use it Regulations will probably add more and more constraints The increase in air traffic will affect procedures and working methods With the introduction of remote towers, the controller will need to have a broader set of skills as he/she will have to do everything
Airport operations	Certain airport jobs will become obsolete whereas other jobs will be unaffected Some jobs may also be created as a result of technology and automation Operators will need much more automation training Operators will need to gain more expertise in managing health emergencies

UAS operations	• The 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 • The ability to fly a drone manually will remain important because a human operator will need to be able to override the "autonomous" mode of operation • 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. • Pilots with a mix of manned and unmanned aircraft experience may be more employable

Table 6: Top three competency areas for each group of VET users

	VET users			
	Flight crew	Air Traffic Control	Airport operations	UAS operations
Competency area	Dealing with complexity	IT/computer literacy	IT/computer literacy	Technical expertise
	Adaptability	Adaptability	Technical expertise	Dealing with complexity
	IT/computer literacy	Technical expertise	Problem solving	Adaptability

Discussion

As mentioned in the results, the majority of flight crew and ATCOs claimed to have followed a training programme prior to employment, whereas only around half of those involved in airport operations and UAS operations claimed that they did. This considerable difference can be explained by the fact that the training of flight crew and ATCOs is highly regulated and structured, whereas this is not necessarily the case for airport and UAS operations. For flight crew and ATCOs, the job requires a licence which is only obtained after completing a formal training programme which normally takes 18 to 24 months to complete. On the other hand, the majority of new airport employees are given on-the-job training, without having been formally trained beforehand. In the case of UAS operations, training has been neither well-regulated nor harmonised between countries (until now).

Some of the training gaps and issues were pointed out by multiple categories of VET users. For instance, the limited amount of human factors training and the lack of exposure to the workplace were both mentioned by flight crew and ATCOs. On the other hand, some training issues are specific to a particular group of VET users. For instance, airport operators mentioned the lack of training on immigration issues and document control, whereas UAS operators stated that current training programmes do not address real-world operations and rarely address specific drone applications (e.g. surveying and agriculture).

A closer look at the gaps and challenges associated with the workplace shows that some of them are clearly linked to training deficiencies, such as: differences between training and real-life; lack of knowledge of technical systems and regulations; and English speaking and writing. For instance, differences between training and real-life are partly due to limitations in the fidelity of simulator training e.g. static weather is used during training, whereas weather is dynamic in real life. Furthermore, simulator training – especially in the case of flight crew – still focuses on failures (e.g. single engine failure on takeoff) which have become extremely rare as aircraft systems have

become more reliable. Instead, the participants stated that it should focus on more essential areas such as Upset Prevention and Recovery Training (UPRT).

Other gaps and challenges associated with the workplace are primarily due to the lack of experience of new employees and/or the unique characteristics of the work environment, implying that certain challenges are unavoidable. For instance, all groups of VET users mentioned challenges related to human factor issues. This is not surprising given that employees in each group work in a team, or have to deal with customers or with their own limitations. For example, ATCOs stated that new employees may be influenced by existing employees who may tell them to forget everything they learnt. Some controllers also said that there exists an unofficial hierarchy where the First Controller is always right even if he/she is wrong. Other gaps and challenges due to the specific nature of the workplace are: dealing with practicalities of the job; adapting to a commercial environment; and handling changes in company SOPs.

As observed from the results, technology and innovation are the key drivers of change. Technology-related changes are expected to be disruptive in the case of UAS operations, and incremental elsewhere. Nevertheless, changes in UAS operations are expected to affect the other groups of VET users as well. Regulation will also have to change, partly due to new technology; however, it will still lag behind technological advancements. In the case of UAS operations, a stronger and more harmonised regulatory framework will be required. In fact, a common EU drone regulatory framework has only recently come into force (primarily through EU Implementing Regulation 2019/947 and Commission Delegated Regulation 2019/945), replacing national rules (European Aviation Safety Agency, 2020). Apart from specific changes in the workplace, the participants also identified various external factors which could affect the work environment (and which are not specific to a particular group of users) such as climate change, contagious diseases (such as the COVID-19 pandemic) and the economy.

The most controversial technological change is probably that related to SPO. Some of the participants 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 airline operations, because it is essential to have two pilots in the cockpit.

All jobs will be impacted by changes in the workplace, albeit to different degrees. Some jobs will be completely replaced by automation. For instance, certain manned flights will be replaced by drones. On the flip side, new jobs will be created as a by-product of new technology and this will necessitate the reskilling and upskilling of workers. This is in line with the view of the World Development Report (World Bank Group, 2019). Furthermore, roles which require Emotional Intelligence (EQ) – such as those that involve human interaction and coordination – are less likely to be affected by new technology. This observation is in line with the findings of Muro et al. (2019).

In the future, workers will rely more on automation and will need to be able to interact with it and manage it effectively. Automation will reduce the level of threats caused by human factor issues, such as in the case of flight crew and ATCOs. At the same time, however, the human being will become the last safety defence and will need to be able to take over if the automation fails. Therefore, the human being (e.g. in a single-pilot cockpit) will need to be more vigilant.

As mentioned in the results, 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. The importance of technology-related skills is in line with the results of other studies such as that carried out by Pomonia et al. (2019). On the other hand, the ability to adapt to changes in the

workplace will depend on factors such as age and attitude. In general, the participants felt that younger people are more likely to adapt than older people because they are more accepting of new technologies and are more exposed to them; they are more willing to take risks (and less afraid of making mistakes); and they have more energy and a desire to prove themselves. However, some participants stated that having the right attitude is more important than age i.e. being open-minded and not resistant to change; being flexible in one's approach; being motivated; and showing an innate interest in learning.

Conclusion

This paper presented the results of an online survey and structured interviews conducted with 204 participants across four groups of VET users in the aviation sector. The survey and interviews identified: deficiencies in training; challenges in the workplace; foreseen changes in the future workplace; and the impact of those changes on jobs and roles. The study highlighted the overlap between training deficiencies and workplace challenges and the similarities and differences between groups of VET users; the role of technology and innovation as drivers of change; and the importance of reskilling and upskilling workers to help them adapt to the future workplace, which will be characterised by a higher degree of automation while still requiring human monitoring and intervention in the event of an emergency.

The results of this work will be used to identify new job profiles (also known as personas) for each group of VET users, such as profiles for remote tower controllers and SPO. Then, study pathways will be created for each job profile, followed by the design of new training programmes and assessment tools. It is expected that these training programmes and assessment tools will address the issues identified in this work and assist aviation workers to adapt to the future workplace.

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