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GREEN SKILLS FOR SUSTAINABLE AIR TRANSPORT

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Abstract

The future occupations in aviation will undergo profound transformations, the main factors of change being new technologies and the transition to a greener and sustainable economy that will require knowledge creation and new skills for employees. The green skills are needed both in core sustainability areas like environmental policies and pollution prevention, but also in transports, IT, services, manufacturing, energy and public administration. The increasing demand for green skills in the job market reflects the growing global concerns of the unsustainable activity impact within the workplace in all areas and, especially, in air transport. Here, these future skill needs are an essential premise for drafting education and training modernized curricula which can contribute to a more sustainable aviation industry.

The aim of this paper is to provide a solid understanding of green skills needed for the new technologies in air transport and for the necessary competences to enhance and manage innovative sustainable systems in this industry. By developing green skills through education and training, the air transport employees will be better prepared and able to generate economic and social benefits while ensuring a safe, efficient and environmentally responsible pathway.

The research methodology involves qualitative and quantitative aspects and results: the qualitative research consists in the in-depth analysis of data on green skills from European Commission, CEDEFOP, The Organisation for Economic Cooperation and Development (OECD) and of reports on qualifications and occupations in air transport from International Civil Aviation Organization and from The Air Transport Action Group. Complementary to this, the paper presents, also, the results of the focus group “New skills for new professions within the air transport industry” organised by UNESCO Chair of UPB with representatives of HE and air transport industry, which brought, to the same table, different perspectives and expertise for identifying the main changes within the field and the prospects for a better reconfiguration of the air transport qualifications. To better understand the current situation and skill needs, the paper presents the conclusions of a quantitative research on new skills necessary for the new smart occupations, the findings being based on a survey who used three questionnaires for top management, employees and teaching staff.

This research is carried out under the Erasmus+ project “Creative Digital Teaching And Learning For Green Air Transport And Logistics (AVIONIC)”, recently started by 6 partners from Finland, France, Romania and Spain, with support of representatives from HE, training, air transport and international and national authorities. The project partners identified there are important changes in skills development and consequently in training needs for the workforce to be able to develop and implement digitalized and sustainable air transports. The project activities are covering the following categories: identification of digital and green skills in air transport, sharing the knowledge on innovative methods for teaching and learning, development of new curricula and teaching and learning materials based on research result on skills and qualifications, development of new digital tools for interactive teaching and learning.

Keywords: air transport, curricula, green skills, new occupations, sustainable development

1 INTRODUCTION

Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, growth must act as a catalyst for investment and innovation, which will underpin sustained growth and give rise to new economic opportunities [1].

Green growth is and will be a major goal and challenge for many local areas and regions. This ambition stems from the desire to address climate change and take advantage of the positive environmental and economic benefits that can result from these efforts. Reducing carbon emissions and achieving a lower carbon economy is crucial in today's world as climate change continues to cause severe economic and social concerns. However, transitioning to a lower carbon economy is a gradual process that requires

significant investments, infrastructure, and specialized skills. The European Union (EU) has recognized this and has set climate targets to be achieved by 2030 and 2050. By setting targets and working towards them, the EU hopes to mitigate the impacts of climate change and promote sustainable economic growth. By 2023, the aim is to reach a 55% emissions reductions target. The 2050 target marks the deadline for realizing the European Green Deal, which aims to make Europe the first climate-neutral continent by 2050 [2]. To do this, the digital and green transitions must be made mutually reinforcing.

The context in which air transport is currently developing is extremely complex and complicated as it is daily confronted with the following 6 challenges:

- Urbanisation: Growing and extending cities lead to the emergence of city-regions or airport cities requiring development of different well interconnected transportation solutions.
- Demographic changes: Demographic composition of the workforce is changing. Demographic changes together with technological innovations will require more flexibility in labour conditions.
- Digitalisation: Technological change is occurring faster, creating a gap between technological innovation and societal progress. Creation of smart cities and smart airports will further push the digitization and deployment of new technologies in air transport, as for example the urban air mobility or advanced air mobility, concepts supposing the development of vertiports.
- Climate change: Climate change, air pollution, noise and the shortage of resources have strong impacts on policy making. The result is societal demand for sustainable transport solutions. The air transport affects the environment, but at the same time it is strongly affected by climate changes that can greatly influence operating conditions.
- Globalisation: We assist to a globalization of airlines and also of airport companies, the consequences being an increasingly integrated global labour markets which will lead to higher mobility across countries and requiring of transversal, international skills.
- Safety and security: The growing concern of governments in relation to terrorism, migration and cyber threats affect the procedure of air transport operations and demand new technologies for developing high cybersecurity systems for the future air transport, particularly in urban air transport.

On a global scale, this context creates a multitude of factors (Fig. 1) which are currently reshaping the workforce across air transport industry: AI and digital transformations, airport city and smart airport concept; advanced air mobility, increasing focus on sustainable development and on societal responsibility; global economic outlook and global labour market; evolving impact of the COVID-19 pandemic; safety and security; evolving expectations of the workforce.

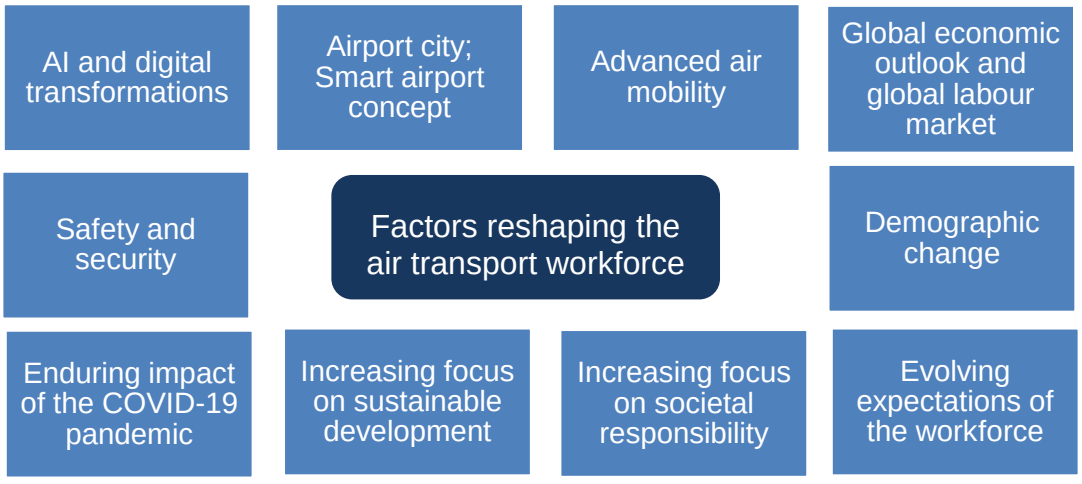

Figure 1. Factors reshaping the air transport workforce

Taking into consideration these factors, we will focus our research on environmental sustainability, on the impact of fighting climate change, on the evolution of green occupations in air transport, on the competences required by these, and on the answer of higher education and training providers in order to ensure the support in developing competences for these challenging interdisciplinary occupations.

Air transport providers are complex ecosystems, with multiple stakeholders performing time-critical functions in a highly regulated environment. Therefore, the air transport lends themselves perfectly to the digitization and automation of complex processes in parallel with addressing their impact on people's livelihoods, on the environment and on local economies. This is essential to maintain the aviation operating license in the context of the ever-increasing social, economic and especially environmental pressures placed on the industry. The leveraging of technologies, such as digitalization and artificial intelligence could lead to the a better result in sustainable development, air transport becoming more flexible, responsive, and proactive in managing activities across multiple stakeholders. That is why managing sustainable development leads to an interdisciplinary approach in education and training.

To address this need, it is essential to develop updated, modernized curricula for education and training that focus on green learning outcomes. These curricula can equip future aviation professionals with the necessary knowledge, skills and attitudes to create a more sustainable aviation industry. By developing study programs dedicated to sustainable development in aviation education and training or by integrating green learning outcomes in existing ones, the industry can reduce its environmental impact and contribute to a more sustainable future.

2 THE METHODOLOGY

The research is developed within the Erasmus+ project*, Creative Digital Teaching And Learning For Green Air Transport And Logistics (AVIONIC),* which has recently commenced with the collaboration of six partners from Finland, France, Romania, and Spain. The project has received support from representatives of higher education, training, air transport, and international and national authorities.
The research approach encompasses both qualitative and quantitative methodologies, yielding a comprehensive set of findings. Specifically, the qualitative component entails a meticulous examination of information related to green skills sourced from the European Commission, CEDEFOP, and The Organisation for Economic Cooperation and Development (OECD). Additionally, reports on qualifications and occupations in air transport from The Air Transport Action Group and the International Civil Aviation Organization (ICAO) are also analyzed.
For anticipating the needs of jobs and of green skills corresponding to them, we undertaken a survey with the following objectives:

1. To identify the air transport needs in terms of occupations, qualifications and skills of employees for the future airport for the next 10 years.
2. To match the learning outcomes of study programs with the demands of airport labour market in terms of competences.
3. To improve the skills of the future generation of airport workers.
4. Particularly, to identify the need of future professionals of air transport in term of green and digital skills.

The survey was carried out using the 3 following questionnaire: the first questionnaire was designed for top management, the directors of companies within the industry, the second questionnaire was intended for employees working within air transport, and the last one was created for academic staff involved in air transport education and training. The questionnaire dedicated to top management was organized by 5 chapters referring to occupations evolution and to the new competences needed, including green and digital skills: Respondent identification, Present situation referring to jobs and training, Future of occupations and jobs, Education and training, Competences. The questionnaire dedicated to employees has 4 chapters referring also to evolution of new emerging occupations and the answer of education and training in term of key competences. The questionnaire for academic staff focused on learning outcomes necessary for graduates to answer to new challenges in terms of new skills and new occupations.

By gathering data from these three different groups, the research provides a comprehensive understanding of the current state of the industry and identifies areas for improvement. The data collected from these questionnaires can inform policy decisions, education and training initiatives, and other efforts aimed at promoting sustainability and reducing the environmental impact of the air transport industry.

3 RESULTS

3.1 Green jobs and green skills for green transport

Our research runs air transport sectoral skills foresight exercises with a forward-looking approach to understand which are the occupations/skills profiles that are necessary for the transition of air transport sector towards a *greener* future, so to accommodate the implications of the European Green Deal, 2030 Agenda for Sustainable Development, the program FIT for 55, Flight Path 2050 Strategy, the ICAO program CORSIA; and how could or should higher education (HE) and vocational education and training (VET) support the development of such skills' sets.

The 2022 Global **Green Skills Report** [3] highlights that the air transport industry needs employees with green skills to support the transition to a green economy. The report emphasizes the importance of skills related to sustainable operations and maintenance, including energy efficiency, fuel efficiency, and emissions reduction.

Although impact is expected across the economy, air transport sector is foreseen to be affected more intensely. Air transport stakeholders and other interested parties that are involved in the provision of skills training would significantly benefit from the identification of new/emerging skills that will affect (or are already affecting) specific occupations of the sector; the ways to make their skills systems more responsive to these rapid changes in the short-term, but also ways to facilitate their response to skills changes in the medium/longer-term.

From the conceptual point of view, we observed that in many of the documents on sustainable development, the term *green skills* is actually used with the meaning of *green competences* or *green learning outcomes. Green skills* are defined by CEDEFOP as *the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society* [4]. According to the Council Recommendation of 22 May 2017 on the European Qualifications Framework (EQF) for lifelong learning*, skills* means *the ability to apply knowledge and use know-how to complete tasks and solve problems* [5]. In EQF document*, skill*s are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). Furthermore, in the same document, *qualification* means *a formal outcome of an assessment and validation process which is obtained when a competent authority determines that an individual has achieved learning outcomes to given standards,* the concept *learning outcomes* being defined as *statements regarding what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and responsibility and autonomy*. The same document states that *competence* means *the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.*

In KAAT Project, we developed a Methodology for a Sectoral Qualifications Framework in Air Transport (SQFAT) [6], where we defined professional competences as an **integrated and dynamic unit of knowledge, skills and autonomy and responsibility**. Of course, within professional competences, we consider the green or digital competences. In our vision, green knowledge is the cognitive dimension of the competence, green skills are the functional – actional dimension and a structural element of the competence. The autonomy and responsibility is the attitude dimension and a structural element of green competence and have to characterize all occupations, being considered as a societal responsibility necessary for all air transport providers.

Analyzing the definitions from the Council Recommendation, the CEDEFOP documents and the specialized literature, we consider that we must distinguish between the notions of *green skills, green competences* and *green learning outcomes*. As such, we are working with the following definitions:

- ✓ ***green skills*** means the ability to apply green knowledge and use know-how to complete tasks and solve problems for sustainable development;
- ✓ ***green competence*** means the proven ability to use green knowledge, green skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development for developing and supporting a sustainable and resource-efficient society;

- ✓ ***green learning outcomes*** means statements regarding what a learner knows, understands and is able to do on completion of a learning process for develop and support a sustainable and resource-efficient society, which are defined in terms of green knowledge, green skills and responsibility and autonomy;

Qualifications or study programs dedicated to sustainable development, according to this approach, cannot be reduced to create/ develop only green skills, but to develop or build the green learning outcomes of human labour resources necessary for new emerging new green occupations or to green attitudes necessary for an important number of existing occupations. The achievement of green learning outcomes will be an asses which could ensure the green competences asked by new emerging occupations for sustainable development. The structural components of green competences are knowledge, skills, attitudes, values which workers need to adapt to greener ways of working, the level and the depth of these being different according to the level and the specificity of the occupation.

For green occupations, the skills necessary for the especially important work tasks can be classified in four groups: engineering and technical skills, science skills, operation management skills, and monitoring skills [7]. Engineering and technical skills are hard skills needed for eco-building, renewable energy design, and energy-saving R&D projects. Science skills are broad and essential for innovation activities, especially in high demand in the utility sector. Operation management skills are necessary for change in organizational structure, life-cycle management, and cooperation with external actors. Monitoring skills refer to technical and legal aspects of business activities, such as environmental compliance inspection and legal standards observance. For the air transport industry, these groups of green skills are linked to the main categories of methods for a sustainable development: operational methods, biofuels produced by various methods; structural methods: new design of airframes and engines; the improvement of the manufacturing and building process itself; ensure the qualifications for personnel.

Besides these hard skills, there is also a growing importance for soft skills, which are important not only for green skills, but also for future skills in general. Soft skills like design thinking, creativity, adaptability, resilience, and empathy are considered critical.

3.2 New skills for new jobs in air transport industry

Through our prior Erasmus+ project *Knowledge alliance in Air transport (KAAT)* [8], extensive research has been conducted, revealing that the greenisation of airports will necessitate fresh qualifications, thereby leading to the creation of new employment opportunities. Examples of such jobs include Energy and Maintenance Engineers, Electrical Engineers/Alternative Vehicle Developers, Climate Change Reversal Specialists, Consumer Energy Analysts, Battery Technicians, and Solar Flight Specialists. Additionally, those involved in the environmental sector will undergo training and technical education [9, 10]. The ongoing AVIONIC project [11] will build upon and enhance the results obtained from our previous efforts, ensuring further progress and development.

Three questionnaires were developed for different groups, including top management from airports and companies, employees working in air transport, and academic staff. The questionnaires aimed to gather data on various aspects of the industry, including sustainability practices, environmental impact, and the need for green skills. By collecting data from these three groups, the research provides a comprehensive view of the current state of the industry and identifies areas for improvement.

The proposed surveys aim to identify the current and future needs of the air transport industry, to ensure that education and training programs are aligned with those needs and are able to equip the next generation of workers with the necessary skills, knowledge and attitudes, and to promote lifelong learning to enable workers to adapt to changing job requirements. These objectives will help the air transport industry stay competitive and meet the demands of the global market while providing high-quality services to passengers and cargo.

Our quantitative research is currently in progress, and we have gathered some partial responses and data up to this point. In this paper we present some of the results obtained from 25 directors and 175 employees from the air transport industry, from more than 10 countries from Europe. We plan to complete the research soon and update the information accordingly.

The survey participants included high-level managers from various sectors of the air transport industry, such as airports, airlines, handling companies, air traffic control, national authorities, and training providers. In addition, the employee respondents had a range of work experience levels spanning from those with limited experience to those with over 25 years of experience in the industry.

According to the survey responses from participating directors, **new jobs related to green energy and environmental protection** have been established in their companies over the last three years. These positions include roles such as quality and environmental manager, ecological specialist, energy efficiency and environment manager, sustainable aviation program manager, environmental expert, sustainable aviation researcher, sustainable airport engineer, airport environmental system manager or director, sustainable airport and environmental risk manager, sustainability consultant, aviation environmental specialist, green lead airport operations manager, and sustainability manager. The employee responses reveal a shared perspective.

According to both managers and employees, green competences are highly valued in the current period and are expected to become even more important in the future. Nearly 70% of employees reported an increase in the importance of green competences over the last 5 years (Fig. 2) and 87% of them anticipate that this trend will continue, with a solid growth in demand for these competences in the next 10 years (Fig. 3). According to the survey, 64% of managers believe that the significance of green skills is on the rise.

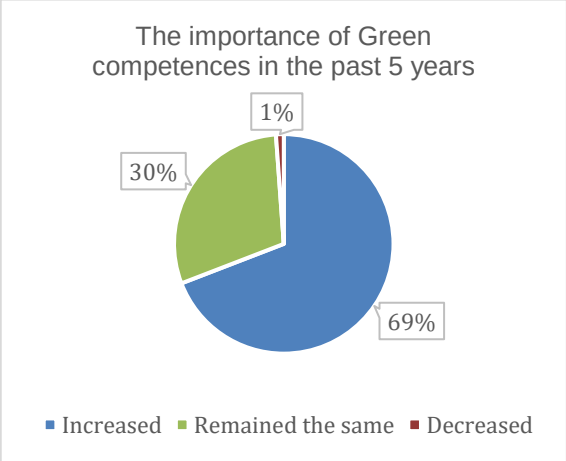

Figure 2. The importance of Green competences the past 5 years (Employees survey)

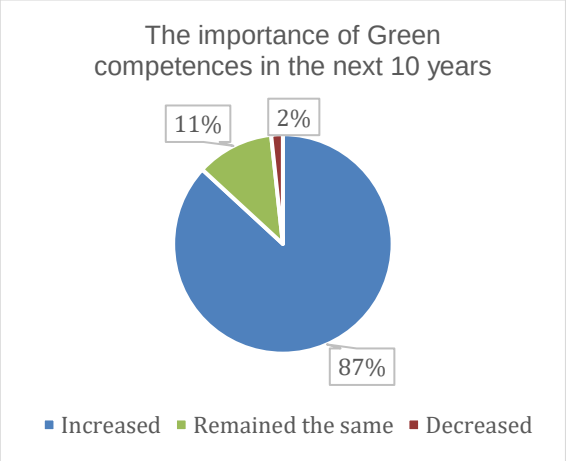

Figure 3. The importance of Green competences in in the next 10 years (Employees survey)

The received survey responses indicate that several significant technologies and developments, such as green aviation technologies, green energy, biofuels, hydrogen technologies, smart buildings, new materials and processes, AI, and management algorithms, will have a considerable impact on the aviation industry in the near future. More than 87% of respondents consider green skills to be highly important in their current occupations, with over 50% rating them as *extremely and very important*. Consequently, it is anticipated that some occupations will undergo significant changes or even disappear by 2030, while new ones will be created in order to keep pace with the dynamic nature of the industry.

Regarding the importance given by air transport employees, they considered teamwork and collaboration, communication, digital skills, quality, responsibility, critical thinking and analysis, and compliance with regulations as the most relevant skills for their current occupation (Fig. 4). Based on the employees' responses, it appears that green competences were deemed unimportant for their current jobs in air transport, receiving the lowest average score among the listed competences (Fig.4).

From the management point of view, **green competences** were not selected as one of the top five skills by almost any department of the institution. (Fig.5 and *Table 1)*.

These preliminary results could indicate that either the concept and content of green skills are not yet well-understood, or that there is currently a low level of interest in these types of skills. Another explanation can be that many people working in the air transport industry are not aware of the policies and programs of the government and of the international institutions for dealing with issues related to environmental protection. The lack of implementation of certain sustainable development strategic documents developed by the EC and ICAO by air transport providers may be another contributing factor to the lack of progress in this field.

Further investigation is necessary to determine the exact reason for this finding. It is important to note, however, that the overall importance of green competences was acknowledged by a majority of respondents, suggesting that this area is worth further exploration and development .

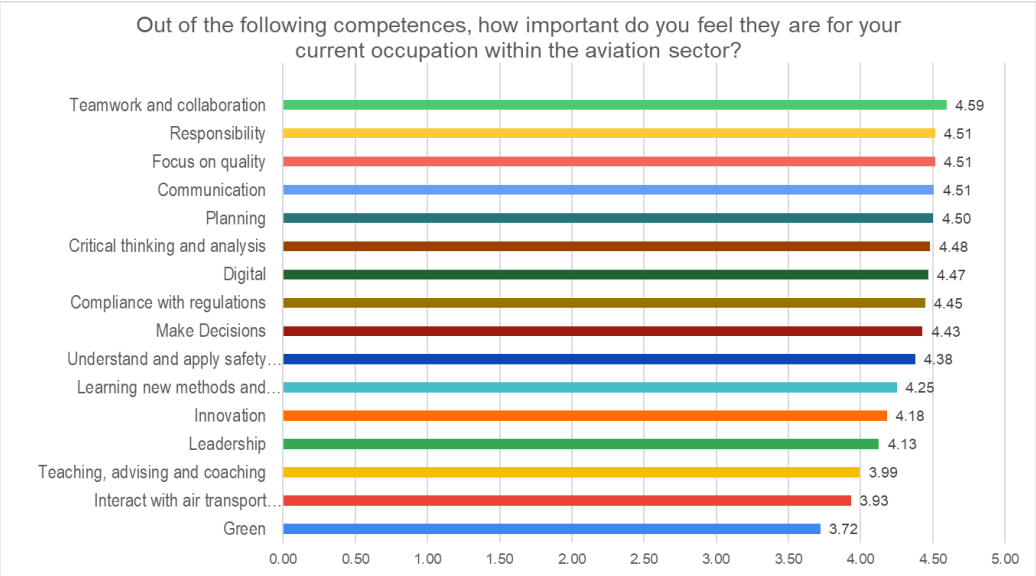

Figure 4. The opinion of employees from air transport about the importance of competences in their current occupation

In addition to *environmental awareness and willingness to learn about sustainable development*, various competences can be considered green competences when examining their definitions in literature and studies. Examples to be mentioned include: strategic and leadership skills, adaptability and transferability skills, coordination, design thinking, systems and risk analysis skills, entrepreneurial skills, innovation skills, communication and negotiation skills, marketing skills. These skills are critical to successfully implementing sustainable practices across different industries, highlighting the importance of considering a diverse range of skills in the development of green skills programs and initiatives. All these skills are the prerequisites for competences listed in fig. 4 and 5.

Table 1. Competences chosen by top management, considering their importance

Field of activity	**Top 5 chosen competences from the provided list**
Management and administration	decision making, teamwork, communication, focus on quality, apply safety rules in work practices, strategic and leadership skills
Air transport operational activities	teamwork, support colleagues, self-knowledge, learning new methods and techniques, problem solving, risk analysis skills
Digitalization of air transport	digital skills, work independently, self-knowledge, think analytically, innovation
Sustainability activities	green skills, apply air transport standards and regulations, communication, interact with air transport users and other stakeholders, innovation
Training	support colleagues, communication, focus on quality, learning new methods and techniques
Other skills proposed than the survey list	*design thinking, adaptability and transferability skills, strategic thinking, risk analysis, data analysis, creativity, adaptability, resilience, empathy.*

The figure from below (Fig. 5) illustrates a matrix question from the survey regarding the importance assigned by top management from air transport to a list of competences, taking into account the specific activities performed by employees in different departments. According to the graphic, the lowest score for green skills (1.88 out of 3) is assigned to the field of air transport management and administration, while those who conduct training and green activities were seen as having the greatest need to develop and achieve this category of skills.

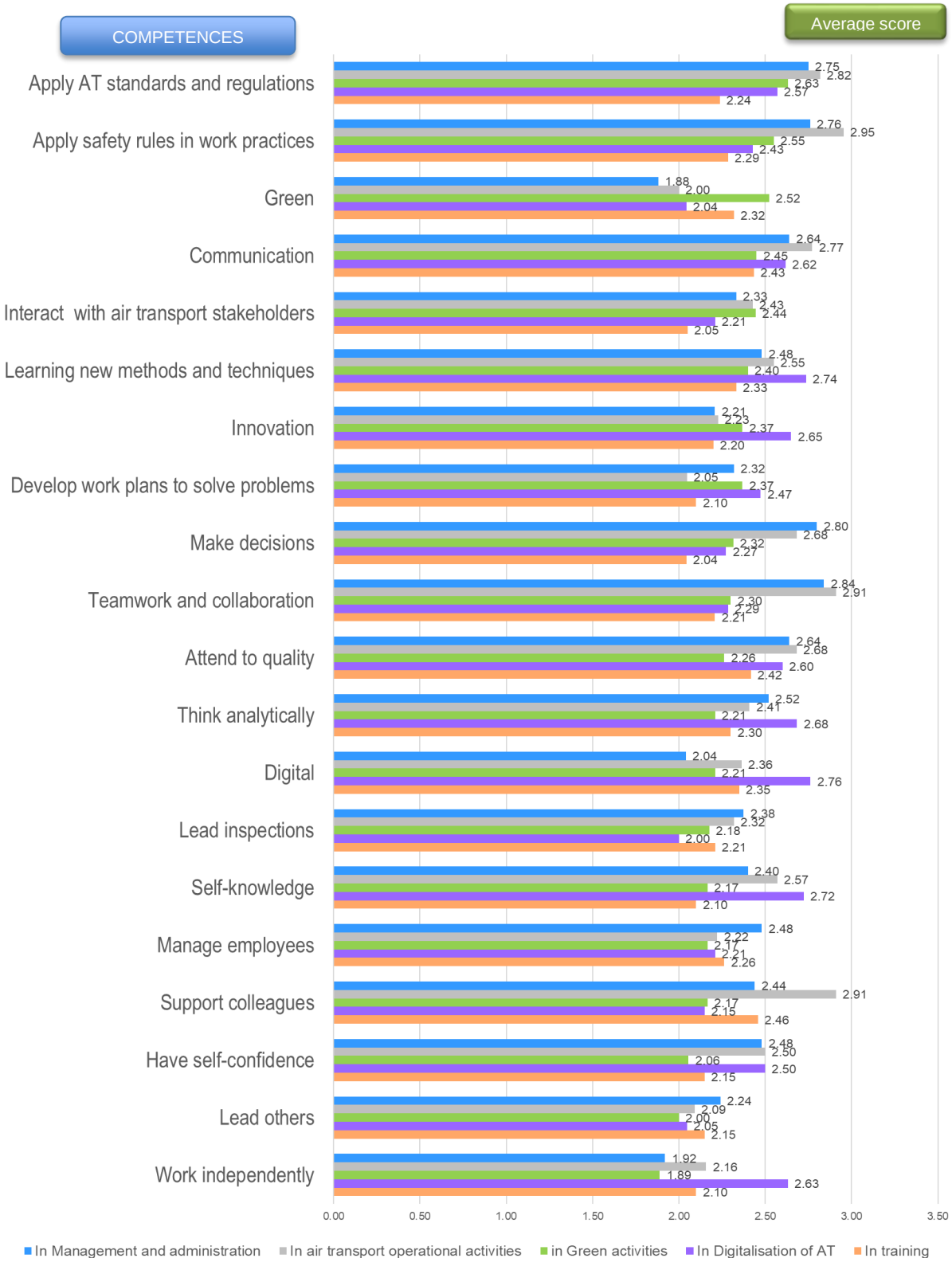

Figure 5. The importance of competences, according to top managers from air transport industry

In addition to the comparative scores from fig. 5, we can observe also the directors who participated in the research believe that green competences are *important or very important* for all categories of activities in air transport industry, as follows: 72% consider green competences *important* for management and administration, of which only 16% consider them *very important*. In air transport operational activities approximately, 74% have attributed importance. Regarding the digitalization of air transport, 82.61% considered that green competences are important for this category, of which almost 22% chose to mention that they are *very important*. The highest percentages were reached for green activities from the institution and for institutional training, where approximately 95% of respondents considered the development of green competences important.

Based on the survey responses received regarding the **responsibility for providing training in the green competences area**, 30% of employees chose initial and recurrent on-the-job training as the preferred type of training. Higher education institutions were also a popular choice, with 28.57% of respondents selecting them. Other notable responses were internships at 25.14% and vocational education and training (VET) at 22.86% (Fig.6). A clarification to be made would be that the respondents were able to select multiple answers to this question; the percentage were calculated as the number of responses received divided by the total sample size of the study.

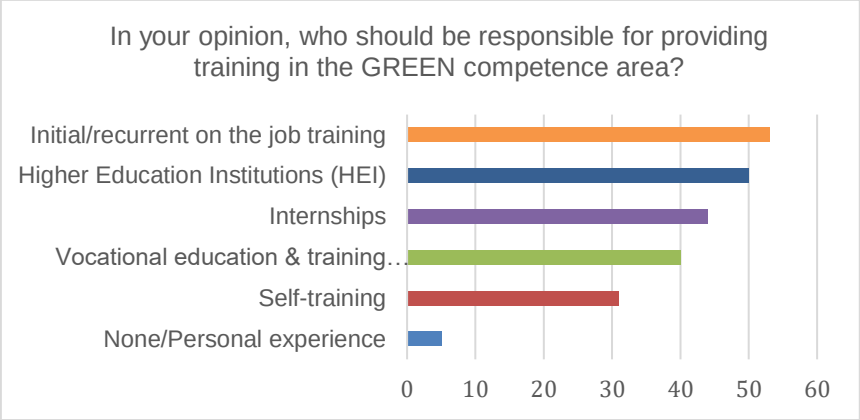

Figure 6. Who should be responsible for providing training in the green competence area?(employees)

4 CONCLUSIONS

The transition to a green air transport impacts the competences skills in several ways: structural changes that increase demand for certain tasks while decreasing others, new air transport activity that generates new occupations and necessitates new skills profiles and training frameworks, and changes in existing occupations and industry due to environmental concerns, necessitating adjustments to current education, training and sectoral qualification frameworks.

The air transport industry is committed to an environmental strategy that is built upon four pillars, and has set ambitious targets to achieve carbon-neutral growth for next years. The four pillars include improvements to technology, operations, infrastructure, and the use of sustainable alternative fuels. By implementing these measures, environmental management will be improved, and airports and airlines will have access to a carbon offset program. Additionally, evaluation systems have been designed to assess and enhance the environmental management of airlines based on compliance with environmental regulations and a commitment to ongoing improvement.

The initial findings of our research suggest that while new green jobs will emerge in the air transport industry, the most significant impact of the green economy will be the transformation of many of the existing occupations. This means that green competences will become essential for all jobs in air transport, constituting a core category of skills. While some jobs will require mandatory green competences, others may consider them only as transversal competences or attitudes. The workforce for all of them needs appropriate training packages to include the areas of the jobs which are most likely to change with the ‘greening’ of skills. That implies the construction of occupational standards for new types of jobs, the revision or the re-alignment of occupational standards for existing jobs, upgrading them for greening, digitalisation and productivity improvements, the design or up-dating of education/training programs or modular training courses for various levels of operational staff up to differing tiers of management in aviation transport sector. Incorporating sustainability into the creation of new and updated occupations, apprenticeships, and technical qualifications is crucial. Similarly, integrating green skills at all levels of education is imperative. Perhaps, the largest demand for green skills development will be in existing occupations which will be enriched with green competences. Within this working population, green competences could be achieved through short courses, which will be aimed at different levels in aviation companies, so that the training given to the operational front-line air transport will be different to that given to strategic management.

The initial results of our planned research are encouraging, but further research is necessary. Currently, the identification of occupations and competences is in its early stages, with some common trends emerging from our analysis. However, a thorough analysis of the questionnaire responses is needed to reach definitive conclusions. Identifying green occupations and competences is just a part in a broader

process. It is also necessary to establish clear and consistent use of sustainable development terminology, including in official documents. The final aim is to use the obtained list to develop curricula and educational programs utilizing innovative approaches and ICT tools, to equip current and future members of the sector with the necessary competences to address the air transport industry's requirements.

ACKNOWLEDGEMENTS

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