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Digital skills in air transport

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Abstract. Aviation is undergoing radical change. Technological advances in aviation mean it is expected to be a much more digital environment than today. To adapt aviation professionals will need to start by adapting the education they receive before and during their careers. AVIONIC, a project funded by the EU through the Erasmus+ programme, aims to change air transport education and adapt it to the digitalisation of the industry. To achieve this, AVIONIC is first developing a methodology to identify digital trends for today's professionals. Firstly, previous works will be analysed in order to find out the theoretical needs that the academy poses for digital aviation and, therefore, the improvement of professionals' skills. With these results, together with the opinion of the expert partners, questionnaires will be developed on future occupations and the competencies that professionals will need to have. This information will make it possible to draw up a list of occupations that will exist in the air transport of the future and competencies that future professionals will need to have to adapt to digitalisation. And the final step will be the creation and update of knowledge and skills for existing and emerging new smart qualifications based on the results obtained. The expected results are summarised in a list of emerging and dissolvable occupations. Once the list is obtained, the idea is to design curricula and programmes based on ICT tools and innovative approaches so that both current and future members of the sector have the competencies required to meet the needs of the industry.

Keywords. Air Transport, Digitalisation, Education, Surveys.

1. Introduction

Air transport has become a strategic sector from an economic, social and technological point of view [1]. Since the beginnings of aviation, this sector has developed thanks to both political and military influences [2], as civilians through technological development [3]. Today, although air transport is considered to be a mature industry, research is still underway to improve it. In particular, IATA [4] expects that by 2050, the carbon footprint will be reduced by 50% compared to the records set in 2019. This will not be possible without revolutionary advances in the field of digitalisation and sustainability within the sector [5]. These changes are intended to change air transport as we know it today. They may include the design of electric or mixed propulsion aircraft [6], or the use of hydrogen or other renewable energies in infrastructures such as airports [7].

The inclusion of these technologies will be a major disruption to aviation and air transport as we know it today. One concern is the preparation of the stakeholders involved in air transport. Experts claim that the sector is not prepared for the changes taking place, putting the focus on the professionals and their qualifications [8]. To be able to adapt to changes in the industry, current and future professionals need help from education. New educational programmes are needed to replace the current ones, focusing on the technological and sustainable development that aviation is undergoing [9].

In order to design new educational programmes, it will first be necessary to discover what occupations and qualifications the professionals of the future will need. For this reason, the discovery of their skills or competences will be the first focus of study when defining educational courses [10].

The AVIONIC project, funded by the EU through the Erasmus+ programme, aims to help these changes that aviation is undergoing with a focus on digitalisation and sustainability. Specifically, from an educational point of view, AVIONIC aims to help current and future professionals by developing new courses, and changing current educational courses. AVIONIC's aim is that these courses will focus on new

occupations in the sector, and that they will help students acquire the necessary skills for the aviation of the future.

For the development of these courses, the first step will be the identification of these new occupations and competences that professionals will have to acquire. Knowing the occupations and competences today is very simple, as there are lists of the different sectors [11]. But for a sector that is trying to change, it is not that simple. This paper therefore presents the methodology proposed in AVIONIC for identifying the occupations and skills that will be needed for digital air transport. Section 2 presents the methodology proposed in this project for the identification of occupations and skills. Section 3 discusses the results obtained in the first phase of the project. However, this project is currently under development and the final results and identification are not yet available. Section 4 discusses the conclusions obtained after the definition of the methodology and the first results.

2. Methodology

To develop courses that focus on acquiring the right competencies, the first step is to correctly define the competencies that professionals need to acquire. AVIONIC considers this first step fundamental for the development and change of educational courses. This section therefore shows the methodology developed for the identification of occupations and competences related to digitalisation in aviation.

This methodology is divided into three main branches:

- First, a review is made of previous work related to the new occupations and competences of aviation professionals, and of research related to the digitalisation of aviation. This first step is essential. By having a good knowledge of the research that has been done, and other projects that have been carried out to study both digitalisation in air transport and related occupations and competences, it will be possible to have references for the identification of these. Having a basis will facilitate the process by not having to start the process from scratch.
- This knowledge will be added to the expertise. AVIONIC is formed by the University Politehnica of Bucharest, Universidad Politécnica de Madrid, University of Strasbourg, Menzies Aviation and Airport College International. These five members have expert professors and professionals who can bring a wealth of knowledge to the process of digitalisation in air transport, and can estimate what occupations will emerge from this and what skills will be needed.
- AVIONIC's knowledge of the acquired references and experts will result in surveys. These surveys seek to involve all other aviation stakeholders. Specifically, surveys have been designed and distributed to educators, employees, and managers from companies across Europe. The aim of these surveys is to align the views of experts and other air transport stakeholders

Figure 1 schematizes the methodology carried out for the identification of future occupations and competencies related to digitalisation in air transport.

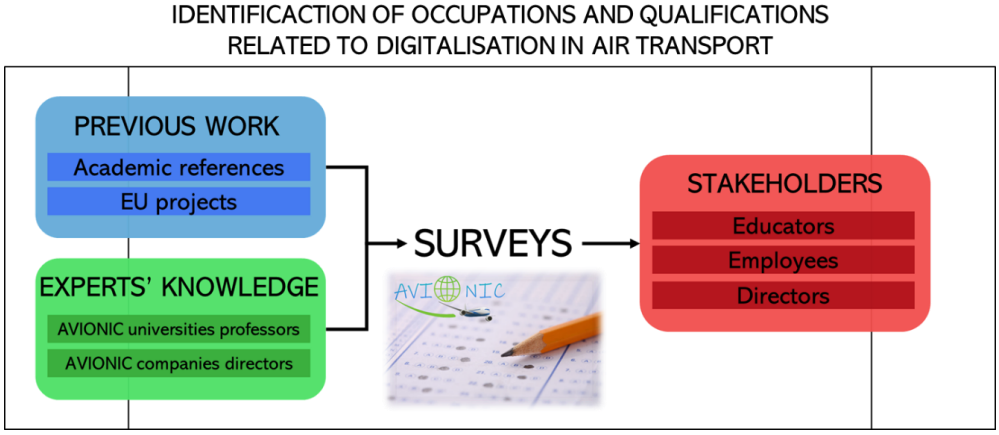

Figure 1. Scheme of Methodology for identification of occupations and qualifications.

With the results of the surveys, the vision of the stakeholders of air transport, being educators, employees and company directors, will be obtained. This knowledge is combined with the previous knowledge obtained by AVIONIC experts, and by other experts in charge of carrying out the research that has served as a reference in this process. The end result of this will be a list of occupations and qualifications needed by air transport professionals once this digitisation process takes place. This list is the basis for the courses that will be developed at AVIONIC, which will help air transport professionals prepare for the change that is occurring in the industry, centred on the digitalisation of air transport.

Each of the parts on which the methodology is based is developed in more detail below.

2.1. Previous Work

The first part of the methodology for the identification of occupations and qualifications is to collect references. These references will be the basis of the process. Previous work in this field has to be used as a basis for the work in order to align the objectives and results with what the industry really needs. To get an overall picture, and to be able to collect work of different nature, the search has been divided into two different parts.

Firstly, an analysis of the conventional state of the art has been made. This provides an academic idea of what kind of research has been carried out, and what lines of development academia foresees in this field. In particular, the identification of occupations and skills needed in digital air transport is a topic that has not yet been extensively researched. For this reason, the aim of this state-of-the-art analysis has been a different one. Articles related to different technological topics that are expected to be included in air transport in the coming years have been analysed. Specifically, the topics "Air transport-artificial intelligence", "Air transport-automation", "Air transport-robotic" and "Air transport-blockchain" were used. In addition, the term "digitalisation" is also used for a broader search. These topics were searched in the Web of Science (WoS) repository. The preliminary result was more than 4,500 articles, but after manual filtering, 890 articles were found to be worth analysing.

The aim of this analysis is to identify the main trends that, according to academia, air transport will follow in the coming years in relation to digitalisation. For this reason, the articles have been analysed, and several main articles have been considered as the ones that will set these trends.

Independently, a search has been made for research projects aimed at the digital development of aviation on both a technical and educational tier. Specifically, the European Union allocates resources to projects that seek to advance along these lines. For this reason, a search has been carried out. The function of this study is to be able to see what work, and what lines of research are being carried out at a more practical tier. This will complement the previous bibliographical analysis.

In this way, by combining both analyses, we have a complete analysis and a good starting point for the identification of occupations and qualifications. This first step allows to align academia and industry with the objectives set.

2.2. Experts' knowledge

In addition to the need for previous work analysis, expert knowledge on a topic allows a broad view on the topic to be obtained. Expert knowledge can determine the results of an investigation [12], It is therefore a tool that must be used if a complete analysis of the current and future situation of the digitalisation of aviation, and of the identification of occupations and qualifications, is to be made. Specifically, two types of experts will be involved in this methodology. The advantage of having different types of experts is that the overall view is broader, losing some of the bias that the experts have in the analysis.

- Academic experts. University professors from the University Politehnica of Bucharest, Universidad Politécnica de Madrid and University of Strasbourg. These professors have extensive experience in both teaching and research. Their opinion and knowledge about the process of digitalisation of

aviation, and about future occupations and qualifications is highly valued. As educators and researchers, these experts have to continuously update their knowledge and be attentive to changes in the industry.

- Company experts. Experts from the companies Menzies Aviation and Airport College International. Having experts who belong to companies gives a more objective picture of how the industry is adapting to the digitalisation process it is undergoing. Having employers on the expert panel gives a more practical understanding of the needs, making identification easier and more objective.

In addition to combining two types of experts, there is also international representation. Specifically, participants from Romanian, Spanish, French and Finnish entities form the panel of experts. This allows to have a more international vision, and to be able to really capture needs, without falling into subjectivity.

This expert opinion, in addition to the identification of occupations and qualifications, has been used to develop the surveys. The surveys contain questions to facilitate the identification of occupations and qualifications, based on the knowledge of the experts, who have made a prior filtering to facilitate their answers. Therefore, the possibility of having experts involved during the development of the methodology is considered very beneficial.

2.3. Surveys and Stakeholders

The last part of the methodology for the identification of occupations and qualifications consists of conducting surveys. With the first two parts of the methodology, expert knowledge has been collected and combined, both from the experts of the identification convention itself and from external experts who have worked on this topic.

But in order to have a general idea of the changes that air transport is undergoing in terms of digitalisation, it is also necessary to have the vision of the different agents involved. To this end, experts have developed a series of surveys that aim to collect this information. The surveys have three target audiences, and therefore there are three versions of the surveys. Figure 2 shows an outline of the organisation of these surveys according to the different target audiences.

Figure 2. Different organisation of surveys depending on the stakeholder targeted.

There are three target groups:

- Educators. They are a key stakeholder. They need to be up-to-date on industry trends in order to impart knowledge to students. In addition, many educators are also researchers, so the need to know the current state and future trends in air transport is even greater.

- Employees. Together with management, they are responsible for driving digital change in air transport. Employees know what the industry is like, how it is evolving and can be a great source of knowledge in identifying future trends.
- Managers. Company managers are the ones who set the direction of the company. This has a major influence on air transport's shift towards digitalisation. It is therefore of great interest to know what they think.

The surveys, although different, have a similar outline. Specifically, in all cases you are asked for your identification and background, although the questions will be different. In addition, in all cases there are two common sections. One for the identification of competences, and the other for the identification of emerging occupations. This is the purpose of the surveys, so having these sections is necessary. These sections are the common ones and the ones that are most important for the purpose of the methodology. Although additional information is collected in all cases. The questions are different because the knowledge needed from each stakeholder is different. In addition, the participation is intended to be international in order to have a broader view.

The results of the surveys, added to the two previous branches, provide a large amount of information to analyse. With this information, comparing the trends set by academia with the real ones seen by the stakeholders in the surveys, and adding the knowledge of experts, it is expected to have a list of emerging occupations and qualifications needed in a digital air transport. This will therefore be the basis for the revolution in education, which will have to adapt to these developments.

3. Results of the first stage

Once the methodology has been defined, its development begins. At present, the whole process has not been completed. The results of the surveys have not yet been collected. Therefore, conclusive results of this part of the methodology have not yet been obtained. The results of the whole process so far are presented below.

First, the analysis of previous work has been carried out. After an analysis of 890 WoS references, it has been decided that 5 references are the ones that mark the main trends that air transport is going to follow in terms of digitalisation. These 5 references are presented in Table 1. In addition, information is added on the topic covered by each of these references and the impact they have on air transport.

Table 1. Summary of selected contributions.

Contributions	Topic	Subject	Impact in Air Transport
[13]	Electric propulsion	Innovative devices	Reduce the carbon footprint
[14]	Vertical take-off and landing	Electric aircrafts	Operations in confined spaces
[15]	Solar radiation models	Artificial intelligence	Safety sustainability and route planning
[16]	Evaluation indicators	Urban mobility regulations	Ease traffic congestion-cut gas emissions
[17]	PEM fuel cell system control	Renewable Energy	Efficiency and sustainability

From these analysed papers, it has been possible to identify 5 trends that will mark the digital development of air transport. These trends are:

- Electric Aircraft
- Virtual and augmented reality
- Artificial Intelligence
- Blockchain

Following this analysis, it is thought that the following technologies are the ones that will mark the future development. With this in mind, it will be necessary to train professionals to acquire the necessary competences to be able to carry out occupations related to these technologies.

Additionally, following the evaluation of projects whose topic is the digitalisation of air transport and future occupations or competences, two projects have been found, within the framework of European Union funding, which can serve as a reference for the identification of competences and qualifications on which to base courses. These projects are KAAT Project [18] and Skill-UP Project [19].

The KAAT project identifies occupations and qualifications for air transport. Therefore, the objective of the project is similar to that of this methodology. Some of the emerging occupations and qualifications identified are:

- Emerging occupations: Remote tower controllers, AI engineers, Drone Operators, Electrical engineer, Big Data analyst, Designer of autonomous vehicles.
- Qualifications: Adaptability, Decision-making, Client management, Compliance with regulations, Continuous learning, Collaboration, Organisation of Work.

Skill-UP project also identifies air transport occupations and qualifications. In this project, the main ones identified are:

- Emerging occupations: Remote tower controllers, Single pilot, Drone Pilot.
- Qualifications: Knowledges of procedures, Situation Awareness, Workload Management, Communication, Working in different roles, Change adaptability, Continuous development, Digital competences.

The identification of trends made after the analysis of bibliographic references, and the identification of occupations and qualifications in the projects is similar. The occupations are focused on drone entry into aerospace, artificial intelligence and blockchain, and virtual reality (Remote ATCO). This seems to indicate that academia and industry are indeed aligned on the trends that air transport will follow. For their part, the competences are generally cross-cutting competences. Some of them focus on the acquisition of digital skills, while others emphasise the need for adaptability. This makes sense, as this digital air transport is expected to be a continuously changing environment, and professionals in the sector will need to be adaptable.

After the identification of competences and occupations by the previous work, an identification is developed by the experts within the AVIONIC convention. These experts have been able to identify some key competences that future professionals should have, and the trends that are guiding the change to digital air transport. With this identification, future occupations could be inferred. This process results in the following identification:

- Trends: New materials, Information technologies, Cooperative systems and interfaces, Big Data, Radars, Augmented and Virtual reality, Incident managing, Logistic tracing and tracking, Green Technologies, Smarts Buildigins.
- Qualifications: Make decisions, Teamwork and Collaboration, Support Colleagues, Communication, Attend to Quality, Apply safety rules, Leadership, apply regulations, Digital competences, Solving

problems, work independently, Self-confidence, Self-knowledge, Management, Interact with clients, Continuous learning, think analytically.

Many of the trends are repeated from previous analyses. For example, augmented and virtual reality, or big data. The concept of smart buildings is related to artificial intelligence and the development of green energy with electric planes. For their part, the competences identified by the experts are once again transversal and many of them are considered in the analysis of previous works. With this analysis, it can be concluded that the experts are also aligned with the changes that are expected to occur.

With these results, surveys have been developed for the different stakeholders to answer. The surveys have been divided into surveys for employees, managers and educators, and their development has been based on the knowledge obtained in the analyses previously discussed. The links to the different surveys are shown below:

- Employees: https://rb.gy/zkzao
- Educators: https://rb.gy/adzqv
- Directors: https://rb.gy/nr6hh

Due to the fact that the project is still at an early stage, it has not yet been possible to analyse the results of the surveys. Nevertheless, a high impact is expected with these surveys thanks to AVIONIC's network of partner contacts. The expected results are 200 employees, 50 educators and 25 managers, from more than 5 countries.

With these surveys, and with the knowledge obtained previously, a comprehensive study will be carried out in the next stage, and it is hoped to obtain a list of occupations of the future to face a digital air transport, and a list with the necessary competences to face this change.

4. Conclusions and Future work

Once a methodology has been developed to identify the key occupations and competences that will guide the digitalisation of air transport, and after having obtained several results, certain conclusions can be drawn.

In particular, it can be concluded that the proposed methodology, being multi-layered, is robust, and allows for an identification process in which a large number of stakeholders are considered. This allows for the elimination of subjectivity in the process, as it is a combination of different opinions. In addition, knowledge from both opinions and documentation is taken into account. This makes the process more robust.

In addition, the results obtained from the analysis of literature, related projects and expert opinion are in the same direction. Digital air transport occupations will be related to artificial intelligence, virtual reality applications, electric aircraft or the use of renewable energies, and the use of Big Data. In terms of skills, most of them are transversal skills, designed to enable the agents of the future to adapt to the continuous changes that aviation will undergo. Professionals will also need to be trained in digital skills, as these will govern air transport. With the analysis that has been carried out, together with the analysis of the surveys, it will be possible to identify these occupations and skills more concretely, and thus design the necessary courses to customise this education.

The results obtained so far with the application of the methodology seem promising, but it is still necessary to continue in this line of research to be able to adapt aeronautical education to the digital changes that this industry is undergoing. Specifically, in the development of this line, the first step is to complete the methodology itself. At present, the identification of occupations and

competences is at an early stage. Certain common trends can be estimated in the analysis carried out so far, but a full analysis of the responses to the questionnaires is needed to draw definitive conclusions.

Moreover, the identification of occupations and competencies, although fundamental, is the first phase and the basis of a broader process. The ultimate goal of this identification is to design educational courses based on these results. So once this identification has been completed, the design of these academic courses will have to begin.

5. References

[1] W. Golebiowski y K. Madej, «Impact of Technology Development on the Air Transport Systems,» *PROCEEDINGS OF THE 20TH INTERNATIONAL SCIENTIFIC CONFERENCE TRANSPORT MEANS 2016,* 2016.

[2] J. Edwards, «Aviation century: World War II,» *LIBRARY JOURNAL,* p. 96, 2005.

[3] B. Seetanah, "Air access liberalization, marketing promotion and tourism development," *INTERNATIONAL JOURNAL OF TURISM RESEARCH,* pp. 76-86, 2019.

[4] IATA, "Aircraft Technology Roadmap to 2050," 2019.

[5] H. Ozel, "Modeling of atmospheric particulate matters via artificial intelligence method," *ENVIROMENTAL MONITORING AND ASSESSMENT,* 2021.

[6] D. Sziroczak, I. Jankovics and I. R. D. Gal, "systems, Conceptual design of small aircraft with hybrid-electric propulsion," *ENERGY,* vol. 204, p. 117937, 2020.

[7] M. Alruwaili and L. Cipcigan, "Optimal Grid-Connected Hybrid Renewable Energy System for a Civilian Airport," *2022 IEEE INTERNATIONAL CONFERENCE ON ENVIRONMENT AND ELECTRICAL ENGINEERING AND 2022 IEEE INDUSTRIAL AND COMMERCIAL POWER SYSTEMS EUROPE (EEEIC / I&CPS EUROPE),* 2022.

[8] Z. Sorin Eugen, "EDULEARN18: 10TH INTERNATIONAL CONFERENCE ON EDUCATION AND NEW LEARNING TECHNOLOGIES," EDULEARN Proceedings, 2018.

[9] O. Schauer, «AN EDUCATION PROGRAM TO INCREASE KNOWLEDGE OF SUSTAINABLE TRANSPORTATION,» de *INTED2014: 8TH INTERNATIONAL TECHNOLOGY, EDUCATION AND DEVELOPMENT CONFERENCE*, Valencia, Spain, 2014.

[10] P. KAAT, "Report on ocuppational analysis Final_Pdf," 2017.

[11] X. Lv, "Detecting User Occupations on Microblogging Platforms: An Experimental Study," beijing, PEOPLES R CHINA, 2017.

[12] V. Varho, N. Nygrén and J. Lyytimäki, "Transport discussion amidst climate challenges: Analysing student, media, and expert framings through the environmental protection process model," *Transportation Research Part D: Transport and Environment,* vol. 24, pp. 10-16, 2013.

[13] A. Kusminska-Fijalkowska, Z. Lukasik and J. Kozyra, "INNOVATIVE SOLUTIONS OF DEVICES WITHIN THE SCOPE OF ENERGY CONSUMPTION APPLIED IN VARIOUS BRANCHES OF

TRANSPORT," *SCIENTIFIC JOURNAL OF SILESIAN UNIVERSITY OF TECHNOLOGY-SERIES TRANSPORT,* pp. 63-177, 2022.

[14] J. R. Agustinho and d. M. B. C. A. Bento, "Operational Requirements Analysis for Electric Vertical Takeoff and Landing Vehicle in the Brazilian Regulatory Framework," *JOURNAL OF AEROSPACE TECHNOLOGY AND MANGMENT,* 2022.

[15] N. F. Attar and M. T. Sattari, "Comprehensive review of solar radiation modeling based on artificial intelligence and optimization techniques: future concerns and considerations," *CLEAN TECHNOLOGYS AND ENVIROMENTAL POLITICS,* 2022.

[16] C. Al Haddad and M. Fu, "Choosing Suitable Indicators for the Assessment of Urban Air Mobility: A Case Study of Upper Bavaria, Germany," *EUROPENA JOURNAL OF TRANSPORT AND INFRASTUCTURE RESEARCH,* pp. 214-232, 2021.

[17] W. R. W. Daud and R. E. Rosli, "PEM fuel cell system control: A review," *RENEWABLE ENERGY,* pp. 620-638, 2017.

[18] P. KAAT, "KAAT Knowledge Alliance in Air Transport," 2017. [Online]. Available: https://www.kaat.upb.ro/. [Accessed 2023].

[19] S.-U. Project, "Skill-UP," 2019. [Online]. Available: https://www.skillup-air.eu/. [Accessed 2023].