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D4.8 DELIVERABLE

QUANTITATIVE AND QUALITATIVE ASSESSMENT OF EDUCATIONAL SUPPLY

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Executive Summary

This document is the formal outcome of EDUCAIR/WP4 (D4.8 Deliverable) titled "Quantitative and Qualitative Assessment of Educational Supply". The objective of D4.8 Deliverable is threefold: i) to identify and review the existing educational offer (supply-side) in terms of relevant educational programmes (1st and 2nd Bologna Cycle) in Aeronautics and Air Transport (AAT), ii) to identify the expected portfolio of students' competences, and iii) to present and consolidate the results of the online survey and review of Educational Institutes / Universities. This deliverable (D4.8) is part of a series of deliverables (D4.8, D5.9, D6.10), whose the ultimate objective is to review and compare the existing educational offer (supply-side) for all three Bologna cycles (WP4 and WP5) with the industry needs (demand-side analysis in WP6) in terms of competences required in the air transport and aeronautics sector across Europe. The D4.8 Deliverable particularly consolidates and documents the results of the online survey of Educational Institutes / Universities and the desktop review results as input for the gap assessment process in WP8.

The first major part of the deliverable deals with the identification and review of relevant educational programmes in Aeronautics and Air Transport (AAT) by means of a case study approach. Two basic categories of programmes are targeted:

1. Academic / University educational programmes of the 1st and 2nd Bologna Cycles involving explicitly a degree (rather than just individual courses) in AAT.
2. Lifelong Learning (LLL) and Continuing Professional Development / Education (CPD/CPE) programmes in AAT.

The main objective of the review of academic degree programmes offered by Universities / Educational Institutes was to identify the existing educational offering (list of relevant programmes). The primarily targeted educational programmes were engineering programmes at 1st and 2nd Bologna cycles in EU27. Furthermore, integrated Master's engineering programmes (MEng) covering simultaneously both 1st and 2nd Bologna cycles were also considered. The list of (engineering) programmes was enriched with undergraduate and graduate programmes in AAT with management (e.g., air transport / aviation management, airport planning and management, airline management) or other relevant orientation (e.g., air safety, aviation technologies, aircraft maintenance, flight

operations). Overall, the existing educational offering contains 251 educational programmes offered by more than 100 Universities / Educational Institutes at 22 European countries.

Selected cases of the identified programmes were thereafter reviewed in more depth mainly with view to key characteristics, structure, and course offering. Relevant information about engineering programmes in the United States with emphasis on the National Center of Excellence for Aviation Operations Research (NEXTOR II) Universities has been also elicited. In total, 44 educational programmes grouped in five categories were reviewed: i) 11 EU Engineering AAT Programmes of the 1st Cycle (1st EU ENG), ii) 17 EU Engineering AAT Programmes of the 2nd Cycle (2nd EU ENG), iii) 8 EU Engineering AAT (MEng) Programmes covering both the 1st and 2nd Cycle (1st+2nd EU ENG), iv) 4 EU Management AAT Programmes of the 2nd Cycle (2nd EU MNG), and v) 4 US Engineering AAT Programmes of the 2nd Cycle (2nd US ENG).

A dominant observation stemming from the analysis of the reviewed programmes is that engineering education varies considerably with the different educational systems or even with programmes delivered within the same educational system. The engineering profession itself and particularly the "Engineer" interpretation differs across the various European countries and worldwide (PEGASUS Partnership, 2009). In some countries (e.g., Italy, Germany), these variations expand further since there are two different levels of "engineers": an upper level (after 5 years of higher studies) and a lower level (3 to 4 years).

Some harmonization of the educational studies across Europe has been achieved with the Bologna scheme known as 3-5-8 according to the Bologna Declaration and its subsequent refinements. According to the Bologna scheme, European countries were encouraged to rearrange or adapt their educational systems to a three-cycle structure of easily readable and comparable degrees. In response to this, there has been an increasing trend during the last decade towards MEng programmes. MEng programmes have initially appeared in UK but are now increasingly adopted by other countries as well (e.g., Portugal, Bulgaria, Germany). Although there is substantial progress made towards the Bologna Declaration aims and many Universities have adapted their programme structures to the proposed new scheme, the harmonization process has still some way to go. First, it seems that there is not absolutely common denomination of the degrees offered by various programmes. Furthermore, MEng programmes have been adopted and delivered in several different variations. In general, some national systems (e.g., UK, Italy, Germany) demonstrated traditionally two separate cycles (intermediate and longer programme), a fact that resulted in a smoother transition to

the 3+2 Bologna scheme, while other countries followed two cycles (e.g., 2+3 in France, 4+2 in Spain) or even a single 5-year cycle (e.g., Greece) that cannot be directly aligned with the new scheme. As a result, the adoption and alignment with the Bologna scheme, in most cases, was not a straightforward task and required more than simple rearrangement of existing programmes.

An interesting finding of the review was the lack of harmonized accreditation or quality assurance systems. In some countries (e.g., Italy, Greece), national authorities or bodies establish rules upon which accreditation is granted as long as programmes conform to the rules. In other countries (UK, Portugal), degrees are accredited (and periodically re-confirmed) through an "a posteriori" evaluation process by a professional association or government-appointed body. The most typical types of accreditations were those exhibited by UK Universities (e.g. Royal Aeronautical Society, Chartered Institute of Logistics and Transport). As a matter of fact, although professional accreditation / licensing is common, academic (programme) accreditation is sparsely offered. Therefore, there seems to be a need for a European-wide academic accreditation system that will *inter alia* promote quality assurance and student mobility. This system should capitalize on recent initiatives undertaken by the PEGASUS Partnership towards the establishment of a voluntary accreditation system for Aerospace Engineering education in Europe. In addition, it should pursue synergies with other accreditation bodies / associations with special emphasis on: i) the European Network for Accreditation of Engineering Education (ENAEE) offering the EUR-ACE framework, set of standards, and accreditation system for engineering degree programmes at 1st/2nd cycle and ii) the European Association for Quality Assurance in Higher Education offering accreditation models and quality assurance best practices for higher education.

Regarding the educational curriculum and course structure/content, despite some differences between countries, there is an evident pattern and common features among the reviewed engineering programmes. These are summarized below for full 5-year or 3+2 programmes:

- The first two years are mostly focused on courses related to fundamental sciences (e.g., mathematics, chemistry, physics) or basic/general engineering content (e.g., mechanics, electronic engineering, software engineering). Some aerospace engineering topics may be introduced during the second year.

- The third year, which may also lead to an intermediate (Bachelor's or equivalent) degree, introduces more course modules and topics on aerospace engineering that are complemented by general engineering courses.
- The last two years (fourth and fifth) offer specialized and advanced topics on aerospace engineering along with opportunities for undertaking more research-oriented topics in laboratories and industrial internship or final year project. Finally, the last two years of highly specialized studies are typically complemented by general management/business courses, financial/economics courses, as well as aeronautical regulation/law courses.

The logical sequence or dependency relationships among courses, and most importantly, the magnitude of the various course categories (e.g., fundamental sciences, basic/general engineering, aerospace engineering, other general courses, final year project, industrial internship) varies substantially from programme to programme. For example, the industrial internship is often envisaged for the final year of studies, but it can also take place well before (third year) or even not at all. Another notable variation is observed in the magnitude of basic/general engineering courses and mainly other general courses, which may range from few courses to a substantial part of the educational curriculum. Furthermore, the profile of a given programme is also affected by the country and the underlying educational system (PEGASUS Partnership, 2009). As a general rule, countries with a strictly regulated and administered educational system (e.g., Italy, France) demonstrate little variation in their programmes' profiles. On the other hand, countries that traditionally exhibited a decentralized educational system (e.g., UK, Germany) show a larger dispersion and diversity in their programmes' curricula. Along the same lines, other countries (e.g., UK) put strong emphasis on the offering of specialized courses on aerospace engineering hence leaving less room for more general or other courses. Finally, the duration and educational format of the courses may also strongly vary ranging from a few weeks duration to several months and from 3 to 12 ECTS.

An important point that should be highlighted here is that most of the programmes provide - to varying degrees though - the option to their students to freely select a certain number of courses (or ECTS) from the entire course catalogue of the programme, the University or even other cooperating Universities (e.g., PEGASUS partner). This provides ample opportunities for students to shape their own, customized / individual profile and build their own portfolio of competences especially through the selection of elective courses at home or other foreign partner University. The diversity of student profiles contributes to increasing the flexibility and mobility of students and to a more spherical coverage of specialized industry needs. On

the other hand, it makes difficult to assess and compare the educational offering of programmes or Universities since their educational "output" (various student profiles) is already highly customized.

Based on the review of selected programmes, some preliminary estimates of the numbers of engineering students - especially those graduating on an annual basis - have been made. These can provide a starting basis for a first approximation of the pool of engineering graduates (prospective employees) who enter the job market and compete for jobs in the sector on annual basis. According to this estimate, the number of engineering graduates of AAT programmes in 2012 for EU27 (for the sample of 106 Universities and 251 programmes considered relevant to WP4 analysis) can be approximated as follows: i) 5.890 graduates at 1st cycle, ii) 2.370 graduates at 2nd cycle and iii) 2.720 graduates of MEng programmes. Under the assumption that there is a large overlapping between 1st and 2nd cycle graduates (influx from 1st to 2nd cycle) but there is no overlapping (with few exceptions, e.g., in the Netherlands) between 1st cycle and MEng programmes, it is reasonable to expect that the overall population of aerospace/aeronautical engineering graduates at both cycles should be roughly between 9.000 and 10.000 in 2012. Certainly, this is only a rough approximation that should be treated with caution due to certain assumptions with the most important being the targeted/identified sample of Universities/Educational Institutes and educational programmes, the estimated average numbers of graduates for each category of programme, as well as the degree of overlapping between 1st and 2nd cycle graduates.

The review process contained also a parallel task dealing with the current offer (supply) of educational curricula of vocational and professional or corporate programmes (CPD) as well as Lifelong Learning (LLL) programmes in air transport and aeronautics. These programmes address a large spectrum of educational, both management and engineering-related orientations / specializations in air transport and aeronautics such as programmes with: i) pure aerospace engineering content, ii) infrastructure, facilitation and maintenance content, and iii) air transport management background. Similarly to the academic degree programmes, a subset of the identified LLL/CPD programmes was further reviewed. These are basically professional or corporate training programmes (e.g., ECATA, Lufthansa Technical Training, Airbus, Emirates College, IATA, ACI), offered by key industry actors or university-industry alliances. An interesting finding of the review of LLL/CPD programmes is that there is no uniform certification or accreditation for those programmes. Besides maintenance training (which is based on international legislation), organizations are seeking

different methods for international accreditation. Furthermore, short courses have focused topics and subjects of study, while programmes of longer duration (>1 year) show a mix of subjects (soft and hard skills). New E-learning programmes like the Harvard and Stanford IATA model have comparable duration with conventional programmes and include 6-11 small courses. Finally, more organizations are delivering facilitating and management programmes, whereas less pure aerospace engineering LLL/CPD programmes were found.

The second major part of this deliverable deals with the Universities' Survey (Survey 3). It involves an online survey of academic staff / faculty members and programme directors / coordinators or heads of departments from academic educational programmes of all 3 Bologna Cycles with emphasis on the 1st and 2nd cycle engineering programmes in AAT. The Universities' survey has received 80 fully completed and applicable online questionnaires from 51 different Universities at 18 countries (16 of which in EU 27). The ultimate objective of this survey was to obtain an aggregate picture of the expected portfolio of student competences that the educational institutions provide to their students as input to the gap assessment in WP8. The competences were derived from the list of competences defined within WP3/ D3.7 Deliverable (EDUCAIR, 2012) and correspond to the high-level categories of competences for each of the four identified demand-side actors (i.e., airlines, airports, ATC/ATM authorities and organizations, manufacturers / suppliers in the AAT sector).

Based on the analysis of the surveyed faculty members, it can be concluded that manufacturers/suppliers-related competences are well balanced and the most frequently covered by the surveyed programmes. The most frequently taught topics pertain to fluid mechanics and acoustics, propulsion, structural design, manufacturing engineering and maintenance, materials and processes, systems engineering and architecture, airworthiness and certification, flight physics, as well as configuration management. Airport-related and ATC/ATM-related competences were found to be partially covered / taught in surveyed programmes. As far as airport-related competences are concerned, the most frequently taught competences pertain to airport operations with emphasis on environmental control, as well as infrastructure planning and design. Regarding the ATC/ATM-related competences, the most frequently taught topics relate to the design, development and evaluation of ATC procedures, the management of air traffic capacity and efficiency, and the supervision and planning of approach operations. Airline-related competences were found to be poorly represented in surveyed programmes with cockpit crew-related competences and competences related to planning, control and ICT being the most frequently taught topics.

The analysis presented in this deliverable provides an overview of the supply-side with particular emphasis placed on the existing educational offering and the expected portfolio of student competences that the Educational Institutes / Universities provide to their students. Further processing and comparison of results between the respective groups of stakeholders (e.g., Universities, Students, Companies, Employees) will be subsequently performed within WP8 in order to identify mismatches - or competence gaps - between the needs (demand) for competences and the offer (supply) of educational programmes aiming to build such competences.

Finally, the rapidly evolving environment in the AAT sector poses continuously changes and new human resource requirements affecting the demand of professional competences for working in the sector. Universities and other educational institutes are asked to keep their programmes up-to-date and enrich their educational curricula accordingly. Due to dynamic industry changes, there is a serious risk that, if competence gaps are not be efficiently addressed by the educational institutions, then these will be further magnified hence eventually affecting the competitiveness of the sector in its entirety. Therefore, it is highly advisable that such studies (like the one performed within EDUCAIR project) will be periodically updated in order to identify convergence or divergence of the competence gaps.

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1 Introduction

The herewith presented document is the formal outcome of WP4 (D4.8 Deliverable) titled "Quantitative and Qualitative Assessment of Educational Supply" and has been prepared within the framework of WP4 of the EDUCAIR Project (Contract Number: 284899). AUEB-RC/TRANSLOG is the main organizational author of this deliverable with input / contribution from IST, UA, TUD and ULPGC.

The objective of this document is threefold: i) to identify (and review part of) the existing educational offer (supply-side) in terms of relevant educational programmes (1st and 2nd Bologna Cycle) in air transport and aeronautics, ii) to identify the portfolio of students' competences developed as a result of the educational process based on the survey results, and iii) to present and consolidate the results of the online survey of Educational Institutes / Universities and the desktop review results (review of selected educational programmes) as input for the gap assessment process in WP8.

This deliverable (D4.8) is part of a series of deliverables (D4.8, D5.9, D6.10), whose the ultimate objective is to review and compare the existing educational offer (supply-side) for all Bologna cycles (1st and 2nd Cycle in WP4; 3rd cycle in WP5) with the industry needs (demand-side analysis in WP6) in terms of competences required in the air transport and aeronautics sector across Europe. The identification and assessment of core competences in air transport and aeronautics was based on the competence gap assessment framework prepared by WP3 and documented in D3.7 Deliverable titled "Assessment Framework".

The assessment of the competences was conducted in three separate, parallel WPs, namely: WP4, WP5 and WP6, each targeting the perspectives of specific group(s) of relevant stakeholders:

- WP4 – Universities (1st and 2nd Level of Bologna) and Graduating Students;
- WP5 – Universities and Research Centres (3rd Level of Bologna), Graduated Students, Doctoral and Post-Doctoral Researchers;
- WP6 – Companies and Employees.

Each WP/deliverable reports only the findings of the respective group(s) of reviewed/surveyed stakeholders. For organizational and methodological purposes, it was decided that the results of the entire Universities' Survey will be separately processed from the results of the Students' survey and their respective analysis / discussion will take place in separate deliverables. Therefore, this deliverable (WP4/D4.8 Deliverable) documents the results of the entire Universities' survey, while the subsequent deliverable (WP5/D5.9

Deliverable) covers the entire Students' (and Researchers) survey. In order to obtain the full picture of the analysis, the reader should refer to all three deliverables documenting the analysis of the respective group(s) of stakeholders. By putting all three streams of work together, a complete view of the demand vis-à-vis the supply-side can be achieved. The comparison of results between the respective groups of stakeholders that will be subsequently performed within WP8 will ultimately identify mismatches - or competence gaps - between the needs (demand) for competences and the offer (supply) of educational programmes / curricula aiming to build such competences. In addition, it provides some preliminary input to WP7 mainly for the assessment of the attractiveness or repulsion factors of the air transport and aeronautics industry.

The document is structured into eight sections as follows:

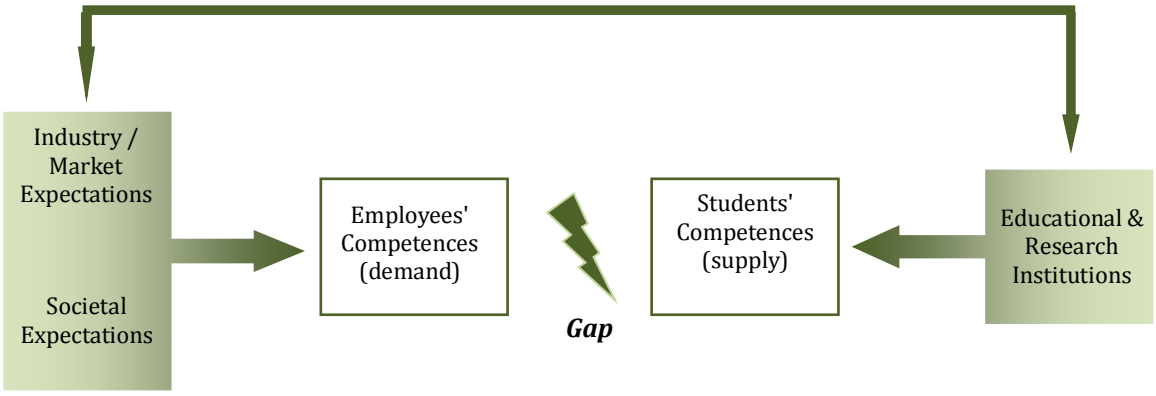
- **Section 1** provides the context and objectives of the present document.
- **Section 2** provides an overview of the EDUCAIR project scope, objectives and the overall project methodology.
- **Section 3** defines the objectives of WP4 and its "positioning" within the EDUCAIR project, while it also presents the WP4 structure and methodological approach.
- **Section 4** describes the review process and discusses the results of the review of selected educational programmes.
- **Section 5** focuses on the analysis of the survey approach and the associated analysis of the survey results.
- **Section 6** summarizes the key conclusions drawn from the review and the survey process and provides some preliminary recommendations as a transition path to WP7 and WP8.

Finally, the deliverable is complemented by the list of reference sources (**Section 7**) and an Appendix (**Section 8**) containing mainly review templates and survey instruments.

2 EDUCAIR Project

2.1 Objectives

The air transport and aeronautics sector is characterized by a very dynamic and rapidly evolving environment involving substantial demand/traffic fluctuations, as well as continuous technological and operational changes. Such changes pose new human resource requirements and needs and indisputably affect the demand of professional competences for working in air transport and aeronautics-related professions. Arguably, the very nature of the professional competences has evolved in parallel with the progressive modification in economies, societies and, ultimately, in the air transport systems. It can be, therefore, concluded that prospective employees have to fulfil the current (and ideally future) needs for competences in order to increase their competitiveness and employment potentials in the sector. Since prospective employees are former students, universities and other educational institutions have to permanently update and enrich their educational programmes and curricula. Due to dynamic industry changes, there is a real risk of mismatch between the prospective employees' competences and the market's (companies) actual requirements (demand-side). If such mismatches are not efficiently addressed by the educational institutions (supply-side), then there is a more significant risk that the developed competence gaps will eventually affect the competitiveness and efficiency of the European air transport and aeronautics sectors (Figure 1).



Source: (EDUCAIR, 2011)

Figure 1 - Potential Competence Gap

The ultimate goal of the EDUCAIR project is to improve the match (or bridge the gap) between needs in human resources and the educational and training offer of skills and competences in the air transport and aeronautics sector across the Europe Union.

In order to accomplish this goal, EDUCAIR pursues the following key objectives:

Key Project Objective (KPO) 1: identify the air transport and aeronautics needs (in terms of staff training and education in the horizon of 2020) of engineers and researchers in aeronautics and air transport.

Key Project Objective (KPO) 2: assess the current educational supply / offer in terms of existing educational programmes, curricula, students and their expected competences.

Key Project Objective (KPO) 3: identify the mismatch - or competence gap - between the needs (demand) of competences and the offer (supply) of educational programmes / curricula aiming to build such competences.

Key Project Objective (KPO) 4: develop recommendations and suggested improvements in the current educational programmes / curricula towards the alignment of the educational offer with the European air transport and aeronautics sectors' competence requirements / needs.

2.2 Scope

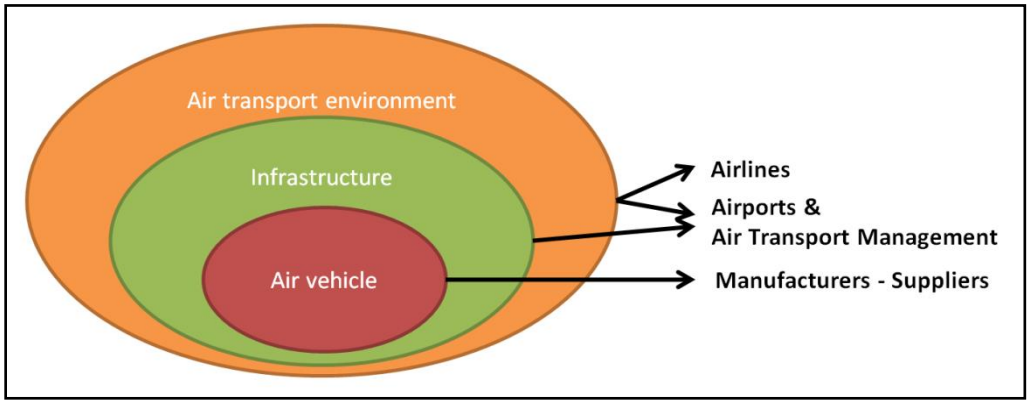
The scope of analysis within the EDUCAIR project has been defined by WP3/D3.7 Deliverable (EDUCAIR, 2012) and splits into the demand and the supply-side which are separately discussed below.

2.2.1 Demand Side

The demand-side refers to the labour market absorbing / recruiting the graduated students in air transport and aeronautics sector. For the purposes of the EDUCAIR project, the scope of the demand-side was defined to include the key sub-sectors corresponding to the large majority of the primary and the derived demand for educated staff in the sector. Foremost, EDUCAIR focuses on the civil aviation labour market and defines the geographical coverage to EU27.

The scope of the demand-side within the framework of EDUCAIR is illustrated in Figure 2. EDUCAIR focuses on four key sub-sectors, being: manufacturers and suppliers of air vehicles,

airports, airlines and companies / organizations dealing with air transport management. It is also important to mention that although air vehicles include both aircraft and helicopters, the latter goes beyond the EDUCAIR scope of analysis.



Source: (EDUCAIR, 2012)

Figure 2 – Demand-side of the aviation market that will be studied within EDUCAIR

At the lowest level, there is the air vehicle. Design and construction of the air vehicle on the one hand and the maintenance of the air vehicle on the other hand can be distinguished. A large fraction of airline costs and activities are related to Maintenance, Repair and Overhaul (MRO). Some airlines do MRO themselves, other use MRO suppliers or rely on the OEM (Original Equipment Manufacturers). Often, there is a combination of all three.

However, as the aeronautics and air transport sector is more than the aircraft, we have to broaden the view and also address the necessary infrastructure and infrastructure management, as well as infostructure, that is needed by the sector, such as airport landside and airside infrastructure management and air traffic control navigation and communication air infrastructure. General air transport management cannot be ignored in this analysis. Air transport management influences the aviation environment, the aircraft specific domains and the infrastructure and makes sure that the different domains and layers work well together.

The third layer comprises the air transport environment. This environment contains aircraft operations and training, the airport operations, air traffic management and the air transport companies (airlines). It is important to add here, that, besides air traffic management, there is also the management of the aircraft design, development, testing, certification, and production of new aircraft along the entire life cycle. Managing an aircraft development and production programme is far more complex than managing an airline or airport and should not be omitted or ignored. The development and production process takes several years and involves hundreds of suppliers at multiple levels. Therefore, technical managers are often

senior engineers after some years of experience and aircraft and equipment producers also employ economists, personnel managers etc.

2.2.2 Supply Side

The supply-side refers to the educational and lifelong learning institutions providing education/training in air transport and aeronautics. For the purposes of EDUCAIR, the scope of the supply-side was defined to include educational institutes / universities (e.g., Universities, Polytechnics, Universities of Applied Sciences) offering engineering education programmes for the 1st and 2nd level of Bologna. For the 3rd level of Bologna (i.e., Ph.D. programmes) and the post-doc research, the scope was broadened to include additional areas of studies such as management/business economics, law, economics/public policy. In addition, lifelong learning programmes (mainly professional or corporate training) aiming to complement knowledge gained through previous education are also examined. Table 1 summarizes the various supply entities falling within the supply-side scope of the EDUCAIR project (highlighted rows correspond to WP4 areas of interest).

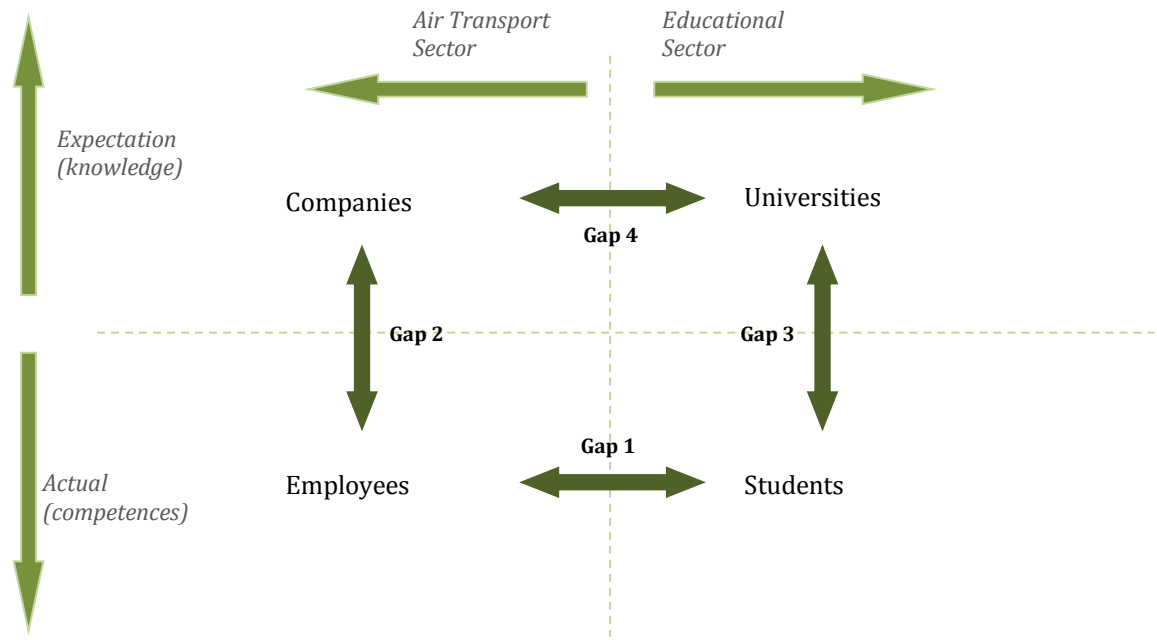
Table 1: Overview of Levels and Types of Education in Air Transport and Aeronautics

	Level of education	**Type of education**
Academic Degree Programmes (Universities, Polytechnics, Universities of Applied Sciences)	1st and 2nd cycle of Bologna	Engineering
	3rd cycle of Bologna	• Engineering • Management/ Business Economics • Law • Economics / Public Policy
	Research (post-doc)	• Engineering • Management/ Business Economics • Law • Economics/ Public Policy
Non-academic: Lifelong learning programmes	Professional / Corporate training programmes	Engineering

Source: (EDUCAIR, 2012)

2.3 Rationale / Gap Assessment Framework

In order to explore the roots and the extent of the eventual divergence or gaps between the demand and the supply of competences, a gap assessment framework has been developed within WP3/D3.7 Deliverable. This is schematically illustrated in Figure 3 (EDUCAIR, 2012).



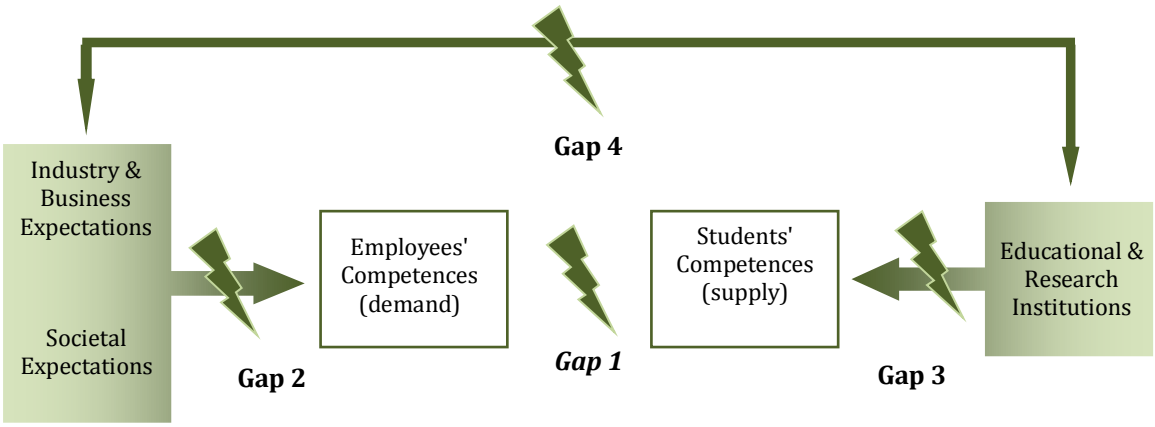
Source: EDUCAIR (2012)

Figure 3 – Gap Assessment Framework

The overall concept of EDUCAIR was based on the assumption that there are more than one potential **Competence Gaps**. These gaps result from several mismatches between the four main entities / actors in both industry and education, being: i) **companies / employers** representing the demand-side, ii) **employees** (working for the companies), iii) **students** (or prospective employees) aiming to build skills and competences through a given educational programme, and iv) **educational institutions** (e.g., universities, research centres) representing the educational offer (supply-side) and aiming to cater students with a set of skills and competences through various educational / training programmes or courses. In particular, four potential gaps are identified (Figure 4):

- **Gap 1**: Gap between the competences that the employees need and the actual competences of the students.

- **Gap 2:** Gap between the competences that the companies need and the actual competences of the employees.
- **Gap 3:** Gap between the competences that the universities (aim to) build and the actual competences of the students.
- **Gap 4:** Gap between the competences the companies need and the competences the universities (aim to) build.



Source: EDUCAIR (2012)

Figure 4 - Competence Gaps

A more detailed description of the various competence gaps along with the definition of the corresponding competences can be found in D3.7 Deliverable (EDUCAIR, 2012).

Figure 5 presents the overall methodological approach of the EDUCAIR project for the assessment of the four competence gaps. The methodological approach is divided into three main stages:

1. **Identification of the Key Competences** and **Conceptual Development** of the competence gap assessment framework – already performed in WP3;
2. **Collection of Relevant Information** (relevant stakeholders' views and perspectives) on the assessment of the current state of those competences - this is the subject of WP4, WP5 and WP6 work;
3. **Assessment of Competence Gaps** - cross comparison between the *demand*-side and the *supply*-side for those competences – this is partially accomplished in WP6 and WP7, and will be further elaborated in WP8.

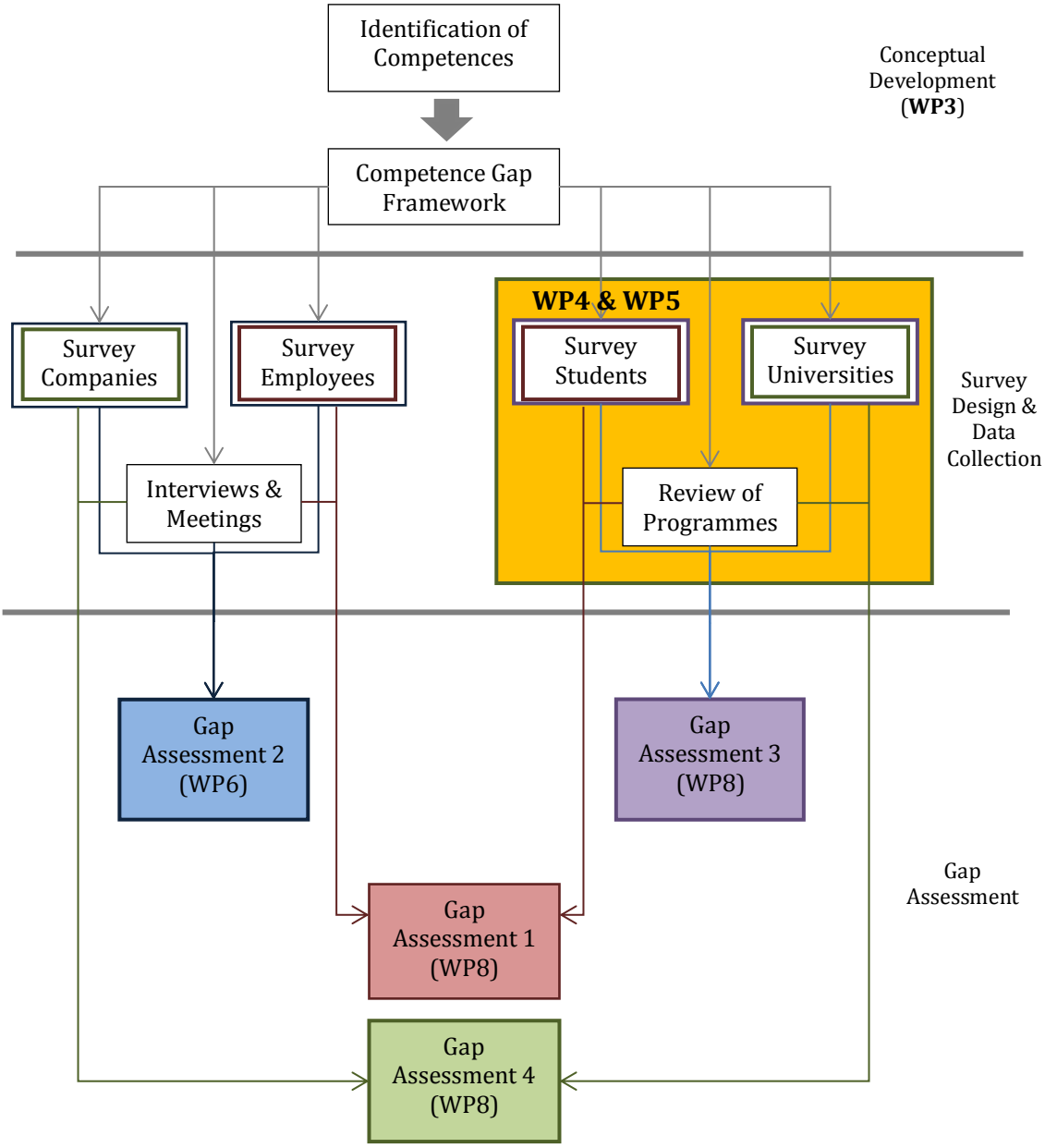


Figure 5 – Overall Methodological Framework

3 Work Package 4

The present deliverable describes the results of the tasks conducted under WP4 (orange shadowed area in Figure 5). This section elaborates further on the WP4 objectives and scope of work, the overall methodology as well as the associated work breakdown structure of WP4.

3.1 Objectives & Scope of Work

WP4 addresses the supply-side of the analysis (**educational survey**) and hence aims to elicit the perspectives and assessments of the educational institutions and students. It is expected to contribute in the high-level EDUCAIR objectives KPO2, KPO3, and KPO4 (Section 2.1) by means of the following:

- ➔ identify (and review part of) the existing educational offering / programmes (1st and 2nd Bologna Cycle) in air transport and aeronautics,
- ➔ provide an approximation of the number of students enrolling these programmes, and
- ➔ identify the actual portfolio of students' competences developed as a result of the educational process.

WP4 interacts closely with (receives input from) WP3 in terms of the overall scope of the EDUCAIR project, the identified list of competences and the gap assessment framework. Furthermore, it provides input to WP7 mainly for the assessment of the attractiveness of the air transport and aeronautics industry, while it also contributes to the assessment of Gaps 1, 3, and 4 in WP8.

From the supply-side viewpoint (**educational survey**), the detailed WP4 scope of work is defined as follows:

- ☑ WP4 primarily covers engineering educational programmes offered by various types of Educational Institutes (e.g. Universities, Polytechnics, Universities of Applied Sciences) at the 1st and 2nd Bologna Cycles. It includes only programmes involving explicitly a degree (rather than just individual courses) in air transport and aeronautics. Universities / Educational Institutes offering only individual - and often basic/introductory - courses

(rather than dedicated programmes[1]) in air transport and aeronautics do not fall within the scope of WP4 analysis.

- ☑ In addition to the typical academic programmes, certain cases of Lifelong Learning (LLL) programmes aiming to complement knowledge gained through previous education will be also examined. The latter category might involve vocational or professional / corporate training. Vocational programmes basically prepare trainees for jobs directly related to a specific occupation and eventually lead to a license in the air transport sector (e.g., Pilot, Air Traffic Controller). Such programmes go beyond the scope of our analysis. Professional or corporate programmes (e.g., ECATA, Lufthansa Technical Training, Airbus, Emirates College, IATA, ACI, ICAO), also found as Continuing Professional Development (CPD) or Continuing Professional Education (CPE), enable people to maintain their knowledge and skills related to their professional lives. CPD/CPE programmes can be often tailor-made and directly targeted to the employees and needs of a given company. Such programmes are mainly offered by key industry actors or university-industry alliances and constitute a target of analysis within WP4.
- ☑ The geographical coverage of the analysis / survey is set to EU27. Comparative findings and examples from other regions (mainly U.S. and international) are considered - where applicable and available - to better analyze or compare with the EU state of affairs.

3.2 Methodology

In order to accomplish the aforementioned objectives, an overall WP4 methodology was developed (Figure 6). Initially, WP4 receives input mainly from WP3 in terms of the overall project scope definition, the gap assessment framework, as well as basic project-level terminology (e.g., competences, gaps, key functions). Based on these prerequisite activities, a more concrete and detailed understanding of the specific WP4 scope and objectives was defined (see Section 3.1). Having defined the scope of work, the next step involves a literature review for the identification of previous relevant data sources or studies (e.g., sectoral studies, technical reports, papers). Exemplary cases providing useful background material are studies/reports published by the PEGASUS Partnership of European Aeronautics and Space Universities (PEGASUS Partnership, 2009), the relevant ASTERA Education Study

[1] Within the framework of the EDUCAIR project, a "programme" is defined as one that consists of a series of air transport and aeronautics-related courses and is formally engaged in teaching and research in the field of air transport and aeronautics. Such engineering educational programmes are officially defined themselves as "programmes", have faculty with expertise in air transport and aeronautics and offer a degree in air transport and aeronautics *per se*.

(ASTERA Consortium, 2004), as well as the "Handbook for Rail Higher Education" (TUNRAIL Consortium, 2011).

The supply-side analysis conducted within WP4 is structured into two core streams of activities; one dealing with an online survey targeting the entire list of relevant programmes and another involving a more in-depth review of selected programmes. In operational terms, it splits into the following methodological steps:

- ➔ Development of an Inventory / List of relevant programmes that were targeted for the survey and/or review process.
- ➔ Development of survey instruments and review templates aiming to guide the data collection process during the survey and review tasks, respectively.
- ➔ Selection of the programmes to be reviewed based on a list of pre-specified criteria (e.g., Bologna level, type of degree, orientation of studies, geographical coverage).
- ➔ Identification, review and assessment of existing educational programmes / curricula (**Review**): this involves a case study approach involving an in-depth review of selected programmes by means of web-based desktop research complemented by short interviews (for additional numerical data or clarifications), as well as secondary sources with emphasis on studies/reports published by the PEGASUS Partnership (PEGASUS Partnership, 2009) and the relevant ASTERA Education Study (ASTERA Consortium, 2004).
- ➔ Identification of a large database with contact details of programme coordinators / directors, department heads or academic staff / faculty members involved in targeted programmes. These have been thereafter used to build targeted mailing lists for supporting the maximum survey outreach.
- ➔ Universities' Survey (**Educational Survey 1**): this activity involves an online survey of academic staff and programme directors / coordinators from relevant academic educational programmes of all 3 Bologna Cycles (with emphasis on the 1st and 2nd cycle). Its main objective is to get feedback and the viewpoints from the "education providers" side in terms of the competences that the educational institutions (aim to) provide to their students, the perceived importance of qualifications and skills for recruitment in the sector, the number of students annually enrolling and graduating from these programmes etc.. For organizational and methodological purposes, **the results of the entire Educational Survey 1 (Universities) are separately (from the Students' survey)**

analyzed and documented in this deliverable and will eventually provide input for the assessment of Gaps 3 and 4 in WP8.

- ➔ Students' Survey (**Educational Survey 2**): this activity involves an online survey targeting graduating students and researchers from the identified academic educational programmes of all 3 Bologna Cycles. Its main objective is to get feedback and the viewpoints from the "education customers" side in terms of the actual competencies acquired by students, the perceived importance of qualifications and skills for recruitment in the sector, their career plans, key variables influencing their decision to select a programme in air transport and aeronautics etc.. As mentioned above, **the results of the entire Students' survey are separately analyzed and documented in D5.9 Deliverable (WP5)** and are eventually expected to provide input for the assessment of Gaps 1 and 3 in WP8.
- ➔ The concluding step of WP4 involves the data analysis in both quantitative and qualitative terms, as well as the final synthesis and documentation of the review / survey results as input for the assessment of the industry attractiveness in WP7 and the gap assessment in WP8.

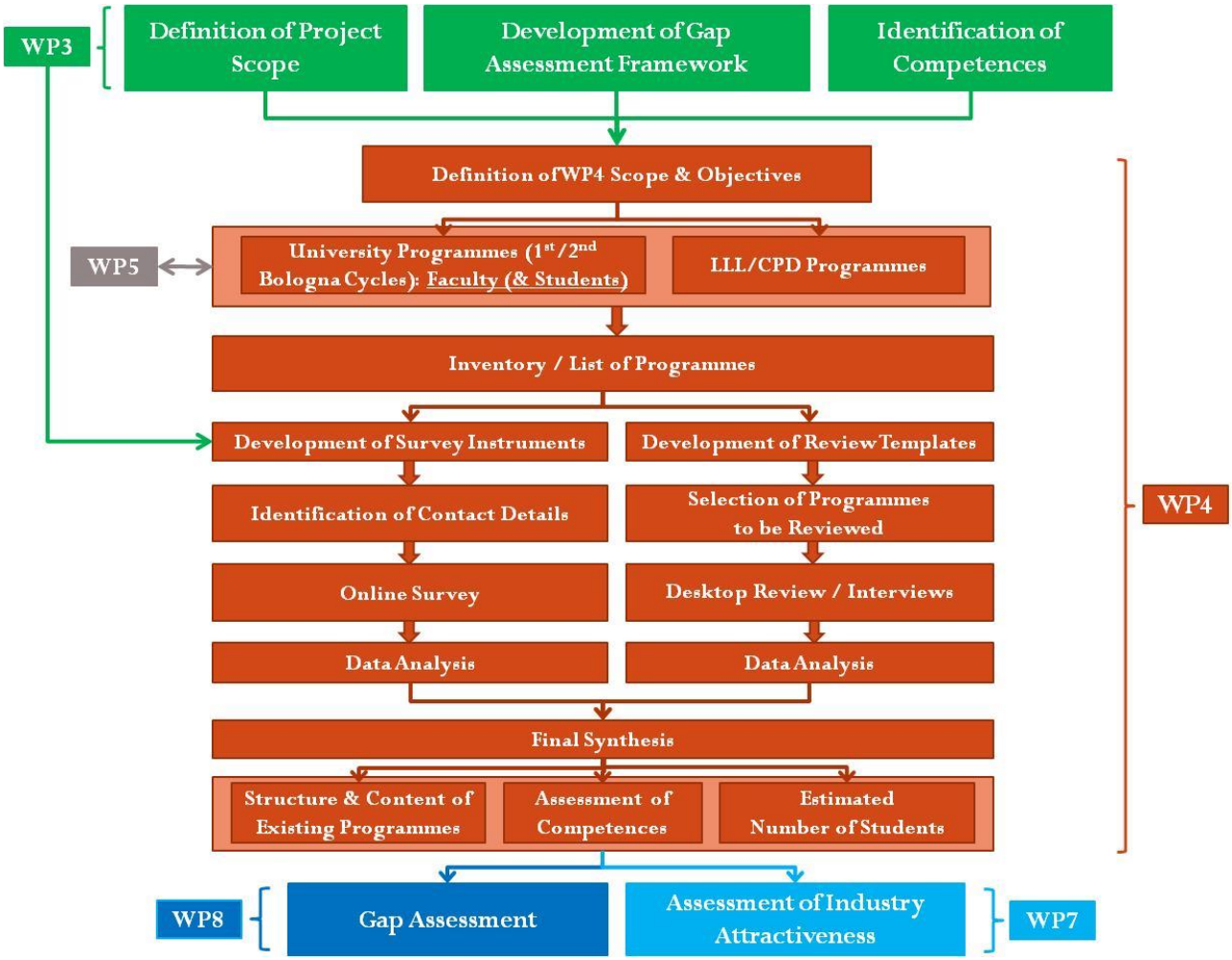


Figure 6 – WP4 Methodological Approach

3.3 Structure

In organizational terms, WP4 splits into three tasks that are further discussed in what follows:

Task 4.1: Review of Current Educational Offer and Curricula (1st and 2nd Bologna Cycles) in Air Transport and Aeronautics

The objective of Task 4.1 is twofold: i) to identify the approximate number of educational programmes and students in air transport and aeronautics and ii) to review and assess the educational curricula of selected educational programmes. The review primarily covers EU27 academic educational programmes (1st and 2nd Bologna Cycles) and LLL/CPD programmes in air transport and aeronautics. Task 4.1 includes the following activities:

- Identification of Existing, Relevant Programmes
- Selection of the List of Programmes to be Reviewed

- Development of Review Templates
- Review of Selected Programs
- Analysis of Review Results
- Documentation of Review Results

Task 4.1 was led by AUEB-RC/TRANSLOG with contribution from IST, UA, and ULPGC (on a voluntary basis) in the implementation of Task 4.1 review. Finally, DUT was responsible for the review of LLL/CPD programmes presented in Section 4.3.

Task 4.2: Survey of Graduating Students and Academic Staff / Programme Directors

The objective of Task 4.2 is to conduct an online survey of graduating students and academic staff / programme directors from the identified academic educational programmes in Task 4.1. The survey was split into two parts (Educational Surveys 1 and 2) targeting both graduating students and academic staff / programme directors involved in the identified academic educational programmes. Its objective was to get feedback and the viewpoints from students and academic staff / programme directors in terms of the actual competencies acquired by students in relation to what is offered by the educational programmes. This task basically conducts a preliminary assessment of expected vis-à-vis actual competences of students as input for the gap assessment exercise in WP8. Task 4.1 includes the following activities:

- Development of the List of Programmes to be Surveyed
- Finalization of (Online) Survey Instruments (in consultation with WP3)
- Identification of Contact Sources / Details for the Survey
- Implementation of the Survey
- Data Analysis
- Documentation of Survey Results

Task 4.2 was led by IST with contribution from AUEB-RC/TRANSLOG, UA, and DUT in the implementation of Task 4.2 survey.

Task 4.3: Final Synthesis

The objective of Task 4.3 was threefold: i) to consolidate the main findings of Task 4.1 review and Task 4.2 survey, ii) to discuss the review/survey results and draw some preliminary conclusions, and iii) to prepare the necessary documentation as input for WP7 and WP8. The main outcome of Task 4.3 was the preparation of the herewith presented document (D4.8

Deliverable: "Quantitative and Qualitative Assessment of Educational Supply"), which is the final and consolidated WP4 Deliverable.

Task 4.3 was led by AUEB-RC/TRANSLOG with contribution from IST, UA, and DUT in the preparation of D4.8 Deliverable.

4 Review of Existing Educational Offer

4.1 Introduction

This section addresses the first stream of the educational survey dealing with the **review** of: i) selected academic / University educational programmes (Section 4.2) and ii) Lifelong Learning (LLL) and Continuing Professional Development / Education (CPD/CPE) programmes in Aeronautics and Air Transport (Section 4.3).

4.2 Review of Academic / University Educational Programmes

This review task employs a case study approach for the review of typical academic degree programmes offered by various types of Educational Institutes around Europe. The targeted/identified Educational Institutes are mainly Universities, but the list includes also Technical Universities, Polytechnics, as well as Universities of Applied Sciences offering relevant programmes as part of tertiary education. The main objective of the review was to identify the existing educational offering (list of relevant programmes) and thereafter review selected cases of those programmes with regards to key characteristics, structure, selection and graduation requirements, student enrolment figures, as well as educational curriculum and competences developed as a result of the educational process (course offering).

The review task run in parallel with and complementary to the online survey process targeting the Universities' stakeholder group. As a risk mitigation measure at project level, this review task aimed not only to collect additional information about the targeted programmes but also to identify candidate programmes for the survey and, most importantly, to complement/enrich the survey results. This is the reason why some (few) questions appear both in the review (template) and the survey (instrument).

The educational programmes that are primarily targeted are engineering programmes in EU27 involving explicitly a degree in Aeronautics / Air Transport (AAT) at both Bologna cycles (1st or 2nd). Furthermore, MEng programmes covering simultaneously both 1st and 2nd Bologna cycles are also considered. MEng programmes (not to be confused with the postgraduate MSc qualification) are integrated Master's (engineering) programmes initially appearing in UK but now adopted in various forms in other countries as well (e.g., Germany, Portugal, Bulgaria). They provide undergraduates, within the scope of a single programme,

with the educational qualifications required for accreditation for a professional career in the relevant area or as preparation for a PhD. The inventory/list of identified programmes goes beyond the original WP4 mandate and it is further enriched with undergraduate and graduate programmes in AAT with management (e.g., air transport / aviation management, airport planning and management, airline management) or other relevant orientation in AAT (e.g., air safety, aviation technologies, aircraft maintenance, flight operations, air and space law). On the other hand, universities offering only individual courses (rather than dedicated programmes) in air transport and aeronautics are not considered. Similarly, the list does not include dedicated programmes leading to flight or other type of professional pilot licensing.

Overall, the list of identified programmes contains 251 educational programmes offered by 106 Universities / Educational Institutes at 22 European countries[2]. Table 2 provides an overview of the existing educational offering in AAT at both Bologna cycles (including MEng) for three generic types of orientations (pure Engineering, Management, Other) of academic degree programmes in AAT.

Table 2: Overview of Existing Academic (Degree) Programmes in AAT

Orientation	1st Cycle	2nd Cycle	1st + 2nd Cycle	ALL
Engineering	64	64	40	**168**
Management	22	23	-	**45**
Other	15	23	-	**38**
ALL	**101**	**110**	**40**	**251**

4.2.1 List of Identified University Programmes

Table 3 presents a comprehensive list/inventory of academic degree programmes in AAT at both Bologna cycles for the three generic types of orientations based on the assumptions / targeted programmes discussed in the previous section. The list has been populated through desktop research complemented by relevant PEGASUS Partnership sources (PEGASUS Partnership, 2009), and eventually validated by the EDUCAIR Consortium and its Advisory Board. It is important to stress here that this list should be only considered as an attempt to identify relevant programmes and outline an overview of the existing educational offering. By

[2] It also includes the EU-sponsored EuMAS Master's Course in Aeronautics and Space Technology that is offered by a Consortium of five European Universities under the umbrella of the EC/DG Culture Erasmus Mundus Programme.

no means, should this list be treated or interpreted as a complete and exhaustive repository of educational programmes.

Table 3: List of Identified Academic (Degree) Programmes in AAT

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
Brunel University (UK)	1st , 2nd	BEng/MEng in Aerospace Engineering BEng/MEng in Mechanical Engineering with Aeronautics BEng/MEng in Aviation Engineering MBA in Aviation Management
Buckinghamshire New University (UK)	1st , 2nd	BA in Airline and Airport Management MSc in Air Transport Management
City University London (UK)	1st , 2nd	BEng/MEng in Aeronautical Engineering BEng/MEng in Air Transport Engineering BSc in Air Transport Operations MSc in Air Transport Management MSc in Air Safety Management MSc in Aircraft Maintenance Management
Coventry University (UK)	1st , 2nd	BSc in Aviation Management BEng in Aerospace Systems Engineering BEng in Aerospace Technology MSc in Applied Aircraft Technologies MSc in Aerospace Manufacturing Engineering MSc in Air Transport Management MBA in Aviation Management MBA in Aerospace Manufacture
Cranfield University (UK)	2nd	MSc in Aerospace Dynamics MSc in Aircraft Engineering MSc in Aerospace Vehicle Design MSc in Astronautics and Space Engineering MSc in Airworthiness MSc in Human Factors and Safety Assessment in Aeronautics MSc in Safety and Accident Investigation (Air Transport) MSc in Airport Planning and Management MSc in Air Transport Management

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
Edinburgh Napier University (UK)	1st	BA in Tourism and Airline Management
Imperial College (UK)	2nd	MEng in Aeronautical Engineering MEng in Aerospace Materials MSc in Advanced Computational Methods for Aeronautics, Flow Management and Fluid-Structure Interaction
Kingston University (UK)	1st, 2nd	BSc in Aerospace Engineering BEng/MEng in Aerospace Engineering, Astronautics & Space Technology BEng/MEng in Aerospace Engineering
Loughborough University (UK)	1st, 2nd	BEng/MEng in Aeronautical Engineering BSc in Air Transport Management
Queen Mary, University of London (UK)	1st , 2nd	BEng/MEng in Aerospace Engineering
Queens University Belfast (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering
Staffordshire University (UK)	1st, 2nd	BSc in Aeronautical Technology MSc in Aeronautical Engineering
University of Bath (UK)	2nd	MSc/MEng in Aerospace Engineering
University of Brighton (UK)	1st, 2nd	BSc/BEng in Aeronautical Engineering MEng in Aeronautical Engineering
University of Bristol (UK)	2nd	MEng in Aerospace Engineering MSc in Integrated Aerospace Systems Design (IASD) MSc in Aerospace Engineering
University of Glamorgan (UK)	1st , 2nd	BSc in Aircraft Maintenance Engineering MSc in Aeronautical Engineering MSc in Aircraft Maintenance Systems
University of Glasgow (UK)	1st , 2nd	BEng/MEng in Aeronautical Engineering MSc in Aeronautical Engineering MSc in Aerospace Engineering and Management BEng/MEng in Aerospace Systems MSc in Aerospace Systems
University of Leeds (UK)	1st, 2nd	BEng/MEng in Aeronautical and Aerospace Engineering
University of Leicester (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
University of Liverpool (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering BEng/MEng in Avionics Systems MSc in Aerospace and Mechanical Systems Engineering MSc in Simulation in Aerospace Engineering
University of Manchester (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering MSc in Aerospace Engineering MEng in Aerospace Engineering with Management
University of Nottingham (UK)	2nd	MSc in Aerospace Technologies
University of Salford (UK)	1st, 2nd	BEng/MEng in Aeronautical Engineering
University of Sheffield (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering
University of Southampton (UK)	2nd	MSc in Aerodynamics and Computation
University of Strathclyde (UK)	1st, 2nd	BEng/MEng in Aero-Mechanical Engineering MEng in Mechanical Engineering with Aeronautics
University of Surrey (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering
University of Swansea (UK)	1st, 2nd	MSc in Aerospace Engineering BEng/MEng in Aerospace Engineering
University of the West of England (UK)	1st, 2nd	BEng/MEng in Aerospace Engineering
University of Westminster (UK)	1st , 2nd	BA/BSc Aviation Management BSc Flight Operations MSc in Air Transport Planning and Management
University of Limerick (IE)	1st, 2nd	BEng/MEng in Aeronautical Engineering
Aalto University (FI)	1st, 2nd	BSc/MSc in Aeronautical Engineering
KTH Royal Institute of Technology (SE)	2nd	MSc in Aerospace Engineering
Linkoping University (SE)	1st	BSc in Civic Logistics and Air Traffic Management and Logistics
Lulea University of Technology (SE)	2nd	MSc in Space Science and Technology
Delft University of Technology (NL)	1st, 2nd	BSc/MSc in Aerospace Engineering
Inholland University of Applied Sciences (NL)	1st	BEng in Aeronautical Engineering
Leiden University (NL)	2nd	LL.M. in Air and Space Law
University of Liège (BE)	2nd	MSc in Aerospace Engineering

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
Catholic College Bruges-Ostend (BE)	1st	Professional Bachelor in Air Transport
RWTH Aachen University (DE)	2nd	MSc in Aeronautical Engineering and Astronautics
Technical University of Berlin (DE)	2nd	MSc in Aeronautics and Astronautics
Technical University of Braunschweig (DE)	2nd	MSc in Aeronautics and Astronautics
Technical University of Dresden (DE)	1st, 2nd	BEng/MEng in Aerospace Technology
Technical University of Munich (DE)	1st, 2nd	BEng/MEng in Aerospace Engineering
University of Stuttgart (DE)	1st , 2nd	BSc/MSc in Aerospace Engineering
Aachen University of Applied Sciences (DE)	1st, 2nd	BEng in Aeronautics and Astronautics MSc in Aerospace Engineering
Bad Honnef - Bonn University of Applied Sciences (DE)	1st, 2nd	BA in Aviation Management MA in International Management – Aviation
Bremen University of Applied Sciences (DE)	1st, 2nd	BEng in Aviation Systems Engineering and Management – Maintenance MEng in Aeronautical Management
Bundeswehr University Munich (DE)	1st, 2nd	BSc/MSc in Aeronautics and Astronautics
Frankfurt am Main University of Applied Sciences (DE)	1st	BA in Aviation Management
Hamburg University of Applied Sciences (DE)	1st, 2nd	BEng in Aeronautical Engineering MSc in Aeronautical Engineering
Munich University of Applied Sciences (DE)	1st	BSc in Aerospace Engineering
Osnabrück University of Applied Sciences (DE)	1st	BSc in Aircraft and Flight Engineering
Saarland University of Applied Sciences (DE)	1st	BSc in Aviation Business and Airline Management
Technical University of Applied Sciences Wildau (DE)	1st, 2nd	BEng/ MEng in Aeronautics / Aviation Logistics MSc in Aviation Management
Worms University of Applied Sciences (DE)	1st	BA in Aviation Management
EBS Business School (DE)	1st	BSc in Aviation Management
Aix-Marseille Université (FR)	2nd	Master Mécanique, Physique et Ingénierie Spécialité Aéronautique et Espace
Arts et Métiers Paris Tech - Centre de Bordeaux - Talence (FR)	2nd	Mastère Spécialisé en Ingénierie Aéronautique et Spatiale (jointly offered in English with ENSEIRB-MATMECA – Bordeaux, BEM, ENSC– Bordeaux and ENSCPB – Bordeaux) Mastère Spécialisé Management de Projets Industriels

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
		Aéronautiques - Maintenance Aéronautique
Ecole Centrale de Lille (ECL) (FR)	2nd	International Master (MSc) in Turbulence (jointly offered in English with ISAE, ENSMA and Ecole Nationale Supérieure d'Ingénieurs from Poitiers)
Ecole Centrale des Arts et Manufactures de Paris (ECP) (FR)	2nd	M2 Recherche Mécanique Aéronautique Spatial Mastère Spécialisé Structures et Systèmes Aéronautiques
Ecole d'Ingénierie des Sciences Aérospatiales (ELISA) (FR)	2nd	Ingénierie Aérospatiale
Ecole National de l' Aviation Civile (ENAC) (FR)	1st, 2nd	BSc in Aeronautical Systems and Services BSc in Air Traffic Management BSc in Air Traffic Safety Electronics MSc ENAC'S Engineers (IENAC) MSc Engineers in Air Traffic Management (ICNA) MSc in Air Traffic Safety Electronics (IESSA) MS Air-Ground Collaborative Systems Engineering MS Communication, Navigation, Surveillance and Satellite Applications for Aviation MSc in Global Navigation Satellite Systems (with ISAE) MS Aviation Safety / Aircraft Airworthiness (with ISAE and Ecole de l'Air) Aviation / Aerospace MBA (with LUISS Business School) MSc in International Air Transport Operations Management (IATOM) MSc in Air Traffic Management (ATM) MS in Aviation and Air Traffic Management MS in Airport Management MS in Air Transport Management MS Aerospace Project Management (with ISAE and Ecole de l'Air)
Ecole Nationale Superieure de Mecanique et D'	1st, 2nd	Engineering degree in aeronautics, transport, mechanics and energy

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
Aerotechnique (ENSMA) (FR)		International Master (MSc) in Turbulence (jointly offered in English with Ecole Centrale from Lille and Ecole Nationale Supérieure d'Ingénieurs from Poitiers) Research-oriented Master's Degrees Research Master of Air and Ground Transportation (with University of Poitiers)
Ecole Supérieure d'Ingénieurs Léonard de Vinci (ESILV) (FR)	2nd	Mastère Scientifique Ingénierie Aéronautique et Economie Durable
ESTACA, Ecole d'Ingénieurs (FR)	2nd	MSc in Aeronautical Engineering
Institut Polytechnique des Sciences Avancées Paris (IPSA Paris) (FR)	1st, 2nd	Ingénieur Spécialiste des Systèmes Aéronautiques et Spatiaux (jointly offered with IPSA Toulouse)
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) (FR)	2nd	SUPAERO Graduate Program ENSICA Graduate Program MSc in Aerospace Mechanics and Avionics MSc in Aeronautical and Space Systems MSc in Global Navigation Satellite Systems (with ENAC) Advanced Masters in Engineering (taught in English) MSc in Aeronautical Engineering (MS TAS Aero) MSc in Aeronautical Maintenance and Support (MS AMS) MS Aviation Safety / Aircraft Airworthiness (with ENAC and Ecole de l'Air) Advanced Masters in Engineering (taught in French) MS EAS - Electronique et télécommunications aérospatiales MS SAS - Structures aéronautiques et spatiales MS SPA - Systèmes de propulsion aérospatiale Advanced Masters in Aviation Safety Management (taught in China) MS Aviation Safety Management - Aeronautical Maintenance (with ENAC and AIRBUS) MS Aviation Safety Management - Aircraft Airworthiness (with ENAC and AIRBUS) MS Aviation Safety Management - Flight Operations (with ENAC and AIRBUS) Advanced Masters in Management (taught in English)

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
		MS in Aerospace Project Management (with Ecole de l'Air and ENAC)
Paul Sabatier University (FR)	2nd	MSc in Mechanical Engineering in Aerospace
SKEMA Business School (FR)	1st	BSc in Aeronautical Science and Management
University of Applied Sciences Wiener Neustadt (AT)	2nd	MSc in Aerospace Engineering
FH Joanneum, University of Applied Sciences (AT)	1st, 2nd	BSc/MSc in Aviation
Czech Technical University in Prague (CZ)	1st, 2nd	BSc in Air Transport BSc in Technology of Aviation Maintenance BSc/MSc in Aerospace Engineering MSc in Air Traffic Control and Management
Brno University of Technology (CZ)	2nd	MSc in Aircraft Design MSc in Aeronautical Traffic
University of Zilnia (SK)	1st, 2nd	BSc/MSc in Air Transport
Technical University Kosice (SK)	1st, 2nd	BSc in Air Traffic Controller BSc in Airport Operation BSc in Avionics Systems BSc/MSc in Air Traffic Management BSc/MSc in Aircraft Operation
Rzeszów University of Technology (PL)	1st, 2nd	BSc/MSc in Aeronautics and Space Technology
University of Information Technology and Management (PL)	1st	BSc in Aviation Management
Warsaw University of Technology (PL)	1st, 2nd	BSc/MSc in Aerospace Engineering
Polytechnic University of Milan (IT)	1st, 2nd	BSc/MSc in Aerospace Engineering
Polytechnic University of Torino (IT)	1st, 2nd	BSc/MSc in Aerospace and Astronautical Engineering
University of Bologna (IT)	1st, 2nd	BSc/MSc in Aerospace Engineering
University of Napoli (IT)	1st, 2nd	BSc/MSc in Aerospace Engineering
University of Padova (IT)	1st, 2nd	BSc/MSc in Aerospace Engineering
University of Pisa (IT)	1st, 2nd	BSc/MSc in Aerospace Engineering
University of Rome 1 ("La Sapienza") (IT)	1st, 2nd	BSc in Aerospace Engineering MSc in Aeronautical Engineering
University of Rome 3 (Roma Tre) (IT)	2nd	MSc in Aeronautical Engineering

University / Educational Institute	Bologna Cycle	Identified Degree Programmes
Barcelona School of Civil Engineering (ES)	1st	BSc in Aerospace Technology
Carlos III University of Madrid (ES)	1st, 2nd	BA in Aerospace Engineering MEng in Aircraft Systems Integration
Polytechnic University of Madrid (ES)	1st, 2nd	BSc/MSc in Aerospace Engineering
Polytechnic University of Catalunya (ES)	1st, 2nd	BSc in Aerospace Technology Engineering BSc in Aerospace Vehicle Engineering MSc in Aerospace Science and Technology
University of Leon (ES)	1st	BSc in Aerospace Engineering BSc in Aeronautical Engineering
University of Seville (ES)	1st	BA in Aerospace Engineering
Universidad Europea de Madrid (ES)	1st	BA in Commercial Aviation and Flight Operations Management
Autonomus University of Barcelona (ES)	1st, 2nd	BSc/MSc in Aeronautical Management
Instituto Superior Técnico (PT)	2nd	MEng in Aerospace Engineering
University of Beira Interior (PT)	2nd	MEng in Aeronautical Engineering
Polytechnic University of Patras (EL)	2nd	MEng in Mechanical Engineering and Aeronautics
University of Belgrade (RS)[3]	1st, 2nd	BSc/MSc in Air Transport and Traffic
Technical University of Sofia (BG)	1st, 2nd	BEng/MEng in Aeronautical Engineering
Polytechnic University of Bucharest (RO)	1st	BSc in Air Navigation
Estonian Aviation Academy (EE)	1st	BSc in Air Traffic Service BSc in Management of Aviation Communication and Navigation Systems BSc in Aircraft Maintenance BSc in Aviation Company Management
Riga Technical University (LV)	1st	BSc in Aviation Transport
Newport University CED (LV)	1st	BSc in Aeronautical Engineering
Vilnius Gediminas Technical University (LT)	1st, 2nd	BSc/MSc in Aerospace Engineering
EuMAS	2nd	European Masters Course (MSc) in Aeronautics and Space Technology

[3] exceptionally considered as a non-EU27 relevant programme.

4.2.2 Selection Criteria for the University Programmes to be Reviewed

A subset of the educational programmes listed in Table 3 was selected for a more in-depth review based on the following criteria: i) full spectrum of engineering programmes in AAT, ii) representation of different types of orientations or subject(s) of studies in AAT programmes, and iii) geographical coverage in EU27.

Based on the above selection criteria, engineering programmes were initially split into three categories covering the 1st, 2nd or 1st and 2nd Bologna cycles together (MEng). For a more detailed and comparable analysis of results, these three categories of engineering programmes were separately processed and analyzed. Furthermore, the review team tried to elicit some respective information about relevant educational programmes in the United States with emphasis on the National Center of Excellence for Aviation Operations Research (NEXTOR II[4]) Universities. NEXTOR II is a Consortium of eight U.S. Universities contracted by the Federal Aviation Administration (FAA) to provide research support on aviation issues. The selected U.S. programmes are offered by Core Members of NEXTOR II (Massachusetts Institute of Technology, University of Maryland, Georgia Institute of Technology, and Purdue University) and involve explicitly a degree in aerospace / aeronautical engineering. The review of relevant engineering programmes was further complemented by the review of some few, well established at European level (graduate) programmes in AAT with management orientation (e.g., Aviation MBA, MSc in Air Transport Planning and Management, MSc in Airport Planning and Management). Finally, special emphasis was placed on the selection of programmes offering a large geographical coverage (EU27) and a broad representation of different educational systems. At the outset, the selected programmes aimed to offer a broad coverage at both geographical and educational (level, type, and system of AAT studies) terms.

For a more systematic and structured review of the selected programmes, a review template (Appendix 8.1) was developed and used by the review team members. The template included mostly closed-ended questions and was structured into three main parts. The first part contained general information about the identity of the reviewer. The second part focused on the educational offer and structure of the programme under review, as well as key characteristics, e.g., selection/recruitment and graduation requirements, student enrolment figures, educational curriculum. Finally, the third part included questions related to generic

[4] http://www.nextor.org/

aspects / issues of the reviewed program such as accreditation labels / certifications, innovative elements and best practices, and cooperation with industry.

4.2.3 List of Reviewed University Programmes

Five categories of programmes were reviewed in total based on the selection criteria discussed in the previous section:

1. 1st Cycle EU Engineering AAT Programmes (1st EU ENG) (Table 4)
2. 2nd Cycle EU Engineering AAT Programmes (2nd EU ENG) (Table 5)
3. 1st and 2nd Cycle EU Engineering AAT Programmes (1st+2nd EU ENG) (Table 6)
4. 2nd Cycle EU Management AAT Programmes (2nd EU MNG) (Table 7)
5. 2nd Cycle US Engineering AAT Programmes (2nd US ENG) (Table 8)

Table 4: 1st Cycle EU Engineering AAT Programmes Reviewed (1st EU ENG)

Country	University	Reviewed Programme	Bologna Cycle	Orientation	Duration (years)
Bulgaria	Technical University of Sofia	BEng in Aeronautical Engineering	1st	Engineering	4
Italy	Polytechnic University of Milan	BSc in Aerospace Engineering	1st	Engineering	3
	Polytechnic University of Torino	BSc in Aerospace and Astronautical Engineering	1st	Engineering	3
	University of Rome 1	BSc in Aerospace Engineering	1st	Engineering	3
Netherlands	Delft University of Technology	BSc in Aerospace Engineering	1st	Engineering	3
Poland	Warsaw University of Technology	BSc in Aerospace Engineering	1st	Engineering	3.5
Spain	Polytechnic University of Madrid	BSc in Aerospace Engineering	1st	Engineering	4
	University of Seville	BA in Aerospace Engineering	1st	Engineering	4
	Carlos III University of Madrid	BA in Aerospace Engineering	1st	Engineering	4
United Kingdom	Loughborough University	BEng in Aeronautical Engineering	1st	Engineering	3
	University of Glasgow	BEng in Aeronautical Engineering	1st	Engineering	4

Table 5: 2nd Cycle EU Engineering AAT Programmes Reviewed (2nd EU ENG)

Country	University	Reviewed Programme	Bologna Cycle	Orientation	Duration (years)
Belgium	University of Liege	MSc in Aerospace Engineering	2nd	Engineering	2
Czech Rebublic	Technical University in Prague	MSc in Aerospace Engineering	2nd	Engineering	2
France	ISAE	MSc in Aeronautical and Space Systems	2nd	Engineering	2
	ISAE	MSc in Aeronautical Engineering	2nd	Engineering	1
Germany	RWTH Aachen University	MSc in Aeronautical Engineering and Astronautics	2nd	Engineering	1.5
	Technical University of Berlin	MSc in Aeronautics and Astronautics	2nd	Engineering	2
	Technical University of Munich	MSc in Aeronautics and Astronautics	2nd	Engineering	2
Italy	Polytechnic University of Milan	MSc in Aerospace Engineering	2nd	Engineering	1
	Polytechnic University of Torino	MSc in Aerospace and Astronautical Engineering	2nd	Engineering	2
	University of Rome 1	MSc in Aeronautical Engineering	2nd	Engineering	2
Netherlands	Delft University of Technology	MSc in Aerospace Engineering	2nd	Engineering	2
Poland	Warsaw University of Technology	MSc in Aerospace Engineering	2nd	Engineering	1.5
Spain	Polytechnic University of Madrid	MSc in Aerospace Engineering	2nd	Engineering	1
Sweden	KTH Royal Institute of Technology	MSc in Aerospace Engineering	2nd	Engineering	2
United Kingdom	Cranfield University	MSc in Aerospace Dynamics	2nd	Engineering	1
	Cranfield University	MSc in Aircraft Engineering	2nd	Engineering	3
European	Consortium of European Universities	European Masters Course (MSc) in Aeronautics and Space Technology (EuMAS)	2nd	Engineering	2

Table 6: 1st and 2nd Cycle EU Engineering AAT Programmes Reviewed (1st+2nd EU ENG)

Country	University	Reviewed Programme	Bologna Cycle	Orientation	Duration (years)
Bulgaria	Technical University of Sofia	MEng in Aeronautical Engineering	1st+2nd	Engineering	5.5
Greece	Polytechnic University of Patras	MEng in Mechanical Engineering and Aeronautics	1st+2nd	Engineering	5
Portugal	Instituto Superior Tecnico	MEng in Aerospace Engineering	1st+2nd	Engineering	5
	University of Beira Interior	MEng in Aeronautical Engineering	1st+2nd	Engineering	5
United Kingdom	Imperial College	MEng in Aeronautical Engineering	1st+2nd	Engineering	4
	Loughborough University	MEng in Aeronautical Engineering	1st+2nd	Engineering	4
	University of Bristol	MEng in Aerospace Engineering	1st+2nd	Engineering	4
	University of Glasgow	MEng in Aeronautical Engineering	1st+2nd	Engineering	5

Table 7: 2nd Cycle EU Management AAT Programmes Reviewed (2nd EU MNG)

Country	University	Reviewed Programme	Bologna Cycle	Orientation	Duration (years)
France	ENAC	MSc in Air Traffic Management	2nd	Management	2
	ENAC / LUISS Business School	Aviation / Aerospace MBA	2nd	Management	1
United Kingdom	Cranfield University	MSc in Airport Planning and Management	2nd	Management	1
	University of Westminster	MSc in Air Transport Planning and Management	2nd	Management	1

Table 8: 2nd Cycle US Engineering AAT Programmes Reviewed (2nd US ENG)

Country	University	Reviewed Programme	Bologna Cycle	Orientation	Duration (years)
United States	Massachusetts Institute of Technology	MS in Aerospace Engineering	2nd	Engineering	2
	Purdue University	MS in Aeronautics and Astronautics	2nd	Engineering	2
	University of Maryland	MS in Aerospace Engineering	2nd	Engineering	3
	Georgia Institute of Technology	MS in Aerospace Engineering	2nd	Engineering	1.5

In line with the WP4 scope of work, the focus of the review and subsequent analysis was indisputably placed on engineering programmes. As it can be inferred from Table 9 below, the sample of reviewed programmes was between 17% and 27% of the identified categories of engineering programmes (1st, 2nd, 1st+2nd). In addition, the review included 4 educational programmes in AAT with management orientation at the 2nd level (Table 7). Although such non-engineering programmes did not fall within the scope of WP4, they were still considered since they also attract engineers for further studies. Finally, 4 relevant engineering graduate programmes offered by NEXTOR II Universities in the United States were also reviewed. The sample of the last two categories (EU MNG and US ENG) was limited, therefore, they were only considered for qualitative analysis as a complement or benchmark to the quantitative analysis of EU engineering programmes.

Table 9: Overview of Reviewed Programmes

	1st Cycle	2nd Cycle	1st + 2nd Cycle
EU Engineering	**11**/64	**17**/64	**8**/40
EU Management	-	**4**/23	-
US Engineering	-	**4**	-

4.2.4 Key Findings of the Review of University Programmes

A dominant observation stemming from the analysis of the reviewed programmes is that engineering education varies considerably with the different educational systems or even with programmes delivered within the same educational system. The engineering profession itself and particularly the "Engineer" interpretation differs across the various European countries and worldwide (PEGASUS Partnership, 2009). In some countries (e.g., Italy, Germany), these variations expand further since there are two different levels of "engineers": an upper level (after 5 years of higher studies) and a lower level (3 to 4 years).

Some harmonization of the educational studies across Europe has been achieved with the Bologna scheme known as 3-5-8 according to the Bologna Declaration in 2000 and its subsequent refinements. According to the Bologna scheme, all European countries were encouraged to rearrange or adapt their educational systems to a three-tier structure of easily readable and comparable degrees based on common terminology and standards. The first cycle (3 years) covers undergraduate studies after 3 years of post-secondary education and typically leads to a degree corresponding to the traditional Bachelor of Science (BSc). The second cycle (after 2 more years from first cycle or 5 years of higher education) deals with graduate studies and leads to a degree corresponding to the traditional Master of Science (MSc). Recently, MEng programmes constitute an alternative integrated Master's (engineering) programme which combines both cycles. They have initially appeared in UK but are now increasingly adopted by other countries as well (e.g., Portugal, Bulgaria). The third cycle (after 3 more years from second cycle or 8 years in total) covers doctoral studies (PhD) that are not applicable to this analysis.

Although there is substantial progress made towards the Bologna Declaration aims and many Universities have adapted their programme structures to the proposed new scheme, the harmonization process has still some way to go. First, it seems that there is not absolutely common denomination of the degrees since BSc-BA and MSc-MS-MA-ME[5] are practically used interchangeably. Furthermore, MEng programmes have been adopted and delivered in several different variations. For example, there are cases in which BEng is explicitly offered as an intermediate (1st) level degree before MEng, whereas other MEng programmes do not offer BEng at entry or offer it only in exceptional cases (if any at all). In general, some national systems (e.g., UK, Italy, Germany) traditionally demonstrated two separate cycles (intermediate and longer programme), a fact that resulted in a smoother transition to the 3+2 Bologna scheme, while other countries followed two cycles (e.g., 2+3 in France, 4+2 in Spain) or even a single 5-year cycle (e.g., Greece) that cannot be directly aligned with the new scheme. As a result, the adoption and alignment with the Bologna scheme, in most cases, was not a straightforward task and required more than simple rearrangement of the existing programmes. In certain cases (e.g., Greece), existing programmes do not follow the Bologna system and provide after full 5-year studies a Diploma Engineer Degree which is equal to a Master Degree and similar to the MEng practice. The variations (especially on the 1st cycle) and degree of alignment of existing engineering programmes with the Bologna scheme can be

[5] In the United States, ME (Master of Engineering) has a duration of one year, while MS (Master of Sciences) often exceeds the one and a half year which also depends on the existence and duration of the final (research) thesis.

easily identified by reviewing the "Duration" column in Table 4, Table 5, and Table 6 in the previous section. It is interesting to note that, based on the duration criterion, only 45% of the 1st EU ENG and 59% of the 2nd EU ENG programmes reviewed adhere to the Bologna 3-5-8 scheme with conformance being even more unclear for MEng programmes.

As far as the U.S. system is concerned, some notable differences can be identified. First, the Bachelor's degree corresponds to four years (+4) of higher education. Second, the overall duration of studies for the Bachelor's and Master's degrees in the United States is not strictly specified by the Universities. In practice, degrees are awarded on the basis of successful completion of a certain number of credits (including often conditions on grades), but there is not typically a (minimum) time limitation on the completion of studies.

In their large majority, all three categories of the reviewed engineering programmes in Europe are hosted by academic entities (e.g., Department, Faculty, School, Institute) in the domain of "Aeronautical / Aerospace Engineering" (Figure 7). In some other cases, a generic or "Other Engineering" discipline / department (e.g., engineering, civil engineering, mechanical engineering) is involved in the offering of the programme. Finally, in some exceptional cases, the programme is offered by "Other" departments (e.g., air transport).

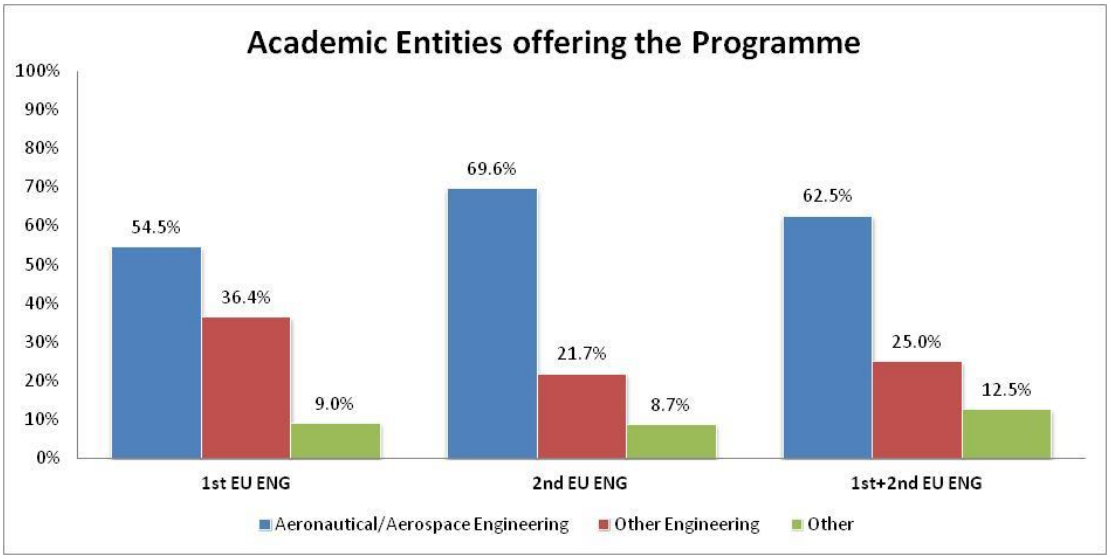


Figure 7 – Academic Entities offering the Programme

In most of the reviewed cases, around 50 faculty members are involved in the programme with a smaller number (around 30) observed in typical 2nd cycle graduate programmes (Figure 8). The corresponding numbers - in terms of the number of faculty members - are comparable for US ENG programmes (around 40) and lower for EU MNG programmes (close

to 20). Finally, more than half of those faculty members are directly involved in AAT educational (research / teaching) activities for all types of engineering programmes.

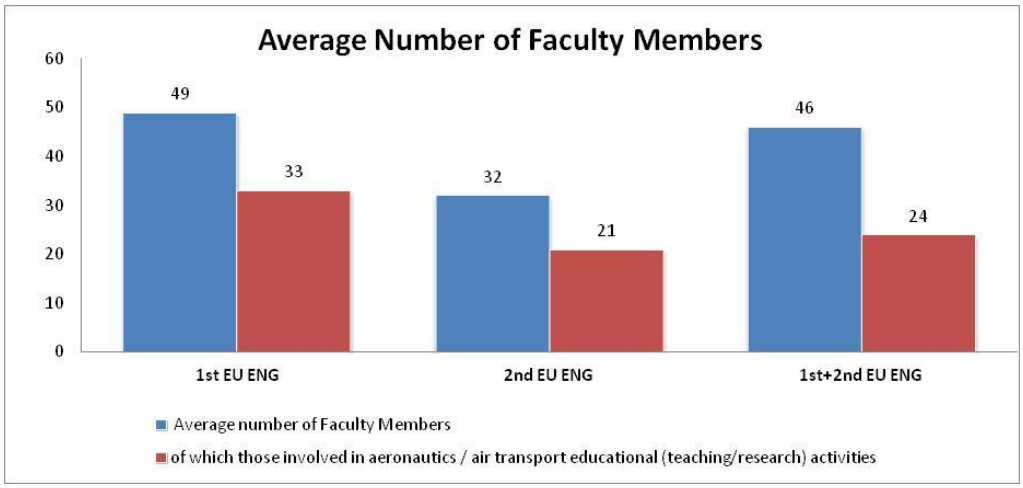


Figure 8 – Average Number of Faculty Members involved in the Programme

Figure 9 provides another measure of size of the academic entity with view to the average number of students enrolling or graduating from a programme on an annual basis. Two interesting observations can be made here. First, the average number of students (enrolling or graduating) of undergraduate engineering programmes is substantially higher as compared to the graduate programmes. This difference would become even more vivid if, for the calculation of average values, extreme cases (e.g., TU Delft enrolling almost 400 students yearly) would have been also taken into account; for the purposes of our analysis, such extreme cases were considered "outliers" and were not processed in quantitative terms. Second, although MEng programmes are integrated Master's programmes offering a 2nd cycle degree, they tend to resemble most with undergraduate engineering programmes in terms of student roster sizes. It is interesting to note here that relevant programmes in AAT with management orientation seem to enrol on average smaller classes of students (around 30).

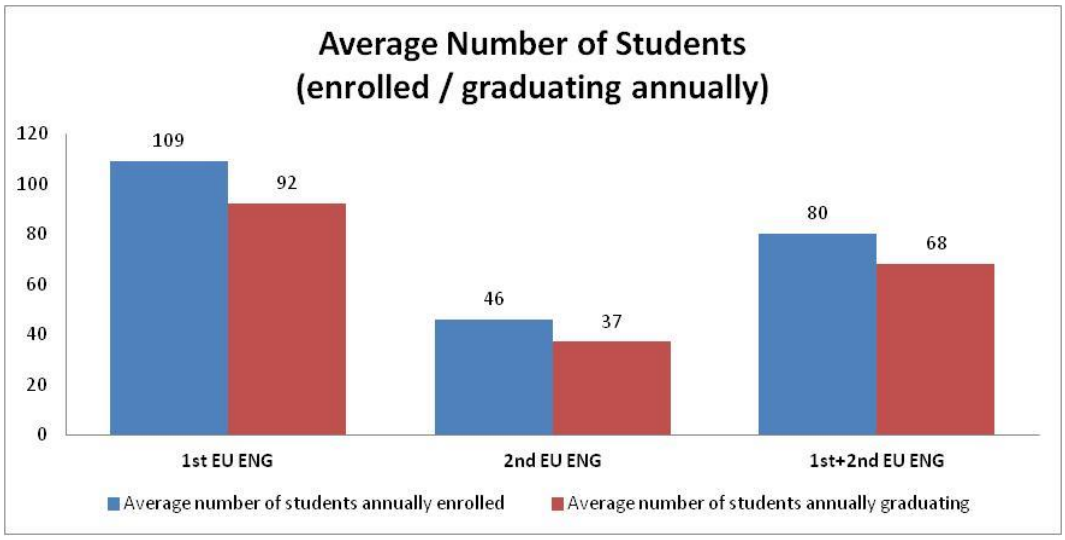


Figure 9 – Average Number of Students in the Programme (enrolling/graduating)

The estimated numbers of engineering students - especially those graduating on annual basis - can provide a starting basis for a first approximation of the pool of engineering graduates (prospective employees) who enter the job market and compete for jobs in the sector on an annual basis. Combining the results of the review of the existing educational offering of engineering programmes (Table 2) and the average number of engineering students (Figure 9), some preliminary conclusions can be drawn on the estimated number of students annually enrolling (influx) and graduating (outflux) from the targeted engineering programmes (Table 10). For example, the annual student outflux for the 1st cycle is computed as the product of the number of 1st Cycle EU Engineering AAT Programmes (64 based on Table 2) with the average number of students annually graduating from 1st EU ENG AAT programmes (92 based on Figure 9). This estimate results roughly to 5.890 students which corresponds to the annual student outflux of 1st Cycle EU ENG AAT programmes (Table 10).

Table 10: Estimates of Numbers of Engineering Students (Influx and Outflux)

EU Engineering Programmes			
Estimates	1st Cycle	2nd Cycle	1st + 2nd Cycle
Annual Student Influx	6.980	2.950	3.200
Annual Student Outflux	5.890	2.370	2.720

Based on the estimation above, the number of engineering graduates of AAT programmes in 2012 for EU27 (for more than 100 Universities and 250 programmes considered relevant to WP4 analysis) is approximated as follows: i) 5.890 graduates at 1st cycle, ii) 2.370 graduates at 2nd cycle and iii) 2.720 graduates of MEng programmes. Certainly, this is only a rough approximation that should be treated with caution due to certain assumptions with the most important being the targeted/identified sample of Universities/Educational Institutes and

educational programmes, as well as the estimated average numbers of graduates for each category of programme.

For the estimation of the overall population of graduates of all cycles, it would be oversimplifying (and overestimating) to sum up the estimated numbers of graduates of each cycle for two reasons. First, the outflux of 1st cycle programmes is typically the influx for 2nd cycle programmes (and therefore, there will be several duplicated "entries"). Second, the graduates of the 2nd cycle may also include engineers having obtained their 1st cycle degree in a non-AAT related topic (and therefore, it would not be accurate to disregard 2nd cycle graduates to avoid double counting). On the other hand, graduates of MEng programmes (1st+2nd) do not typically "overlap"[6] with 1st cycle graduates since MEng are integrated Master programmes covering both cycles at a single degree (and therefore, they can be safely added on top of 1st cycle graduates). Based on the above, and under the assumption that there is a large overlapping between 1st and 2nd cycle graduates (influx from 1st to 2nd cycle), it is reasonable to expect that the overall population of aerospace/aeronautical engineering graduates at both cycles should be roughly 9.000-10.000 in 2012 (for the sample of 106 Universities and 251 educational programmes considered relevant to this analysis). Relevant estimates provided in past studies have considered substantially smaller sets of targeted programmes/Universities that do not allow direct comparisons or some form of verification of our rough estimates. For example, the ASTERA Study (2004) estimated the corresponding influx of freshmen students in 2003 in 30 targeted Universities at more than 4.400 students. For a smaller sample (22 Universities), the PEGASUS Partnership Study (2009) estimated more recently an annual (2006-2008) average number of around 2.760 students at +5 level (Masters included) only for the PEGASUS Network Universities.

On another issue, the international dimension of the reviewed engineering programmes seems to be notable as illustrated in Figure 10. International students account for almost 23%, with the percentage of international students being slightly higher (28%) in 2nd cycle graduate programmes where UK Universities and Delft University of Technology (DUT) have substantial international penetration. Another interesting feature is that many programmes deliver also the courses in a second language (mostly in English, less in French). Nevertheless, the estimated percentages seem to be rather inflated since many programmes apparently reported a second language, while this is only offered in specific course modules within the framework of Erasmus programme or for only a part (e.g., semester, year) of the programme.

[6] with few exceptions (e.g., the Netherlands) where, after finishing, MEng graduates stream in the MSc programme.

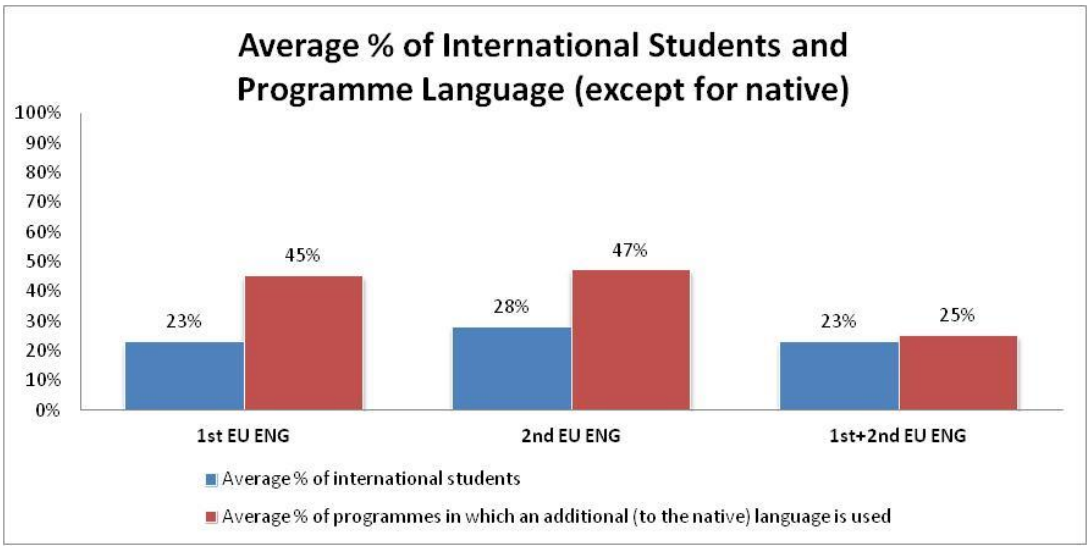


Figure 10 – International Students & Programme Language

Regarding the student recruitment / selection criteria, some form of entry exams (at the University or national level) represents the dominant criterion in undergraduate and MEng programmes. On the other hand, the dominant criterion in graduate programmes of the 2nd cycle is a measure of the Grade Point Average (GPA) with certificates of languages and other specific criteria such as mathematical skills or previous (Bachelor) degree from a relevant engineering department being important as well.

As far as graduation requirements are concerned (Figure 11), successful completion of all required courses (or the equivalent of course credits, e.g., ECTS) is obviously the dominant requirement. Thesis is also an important requirement mostly in 2nd cycle graduate programmes (including MEng). An alternative form is some kind of a final project (or final year project) that is envisaged by many programmes at all cycles. Final exams (under "Other") is an essential criterion in some countries (e.g., 1st cycle engineering programmes in Italy), while spending some time (one semester or year) in industry is a typical option in Universities especially in UK and the Netherlands. The situation is similar for the reviewed EU MNG programmes (courses and final project), but students are usually required to have some form of industrial training. In US ENG programmes, students are typically required to successfully complete all courses and usually a research-based thesis.

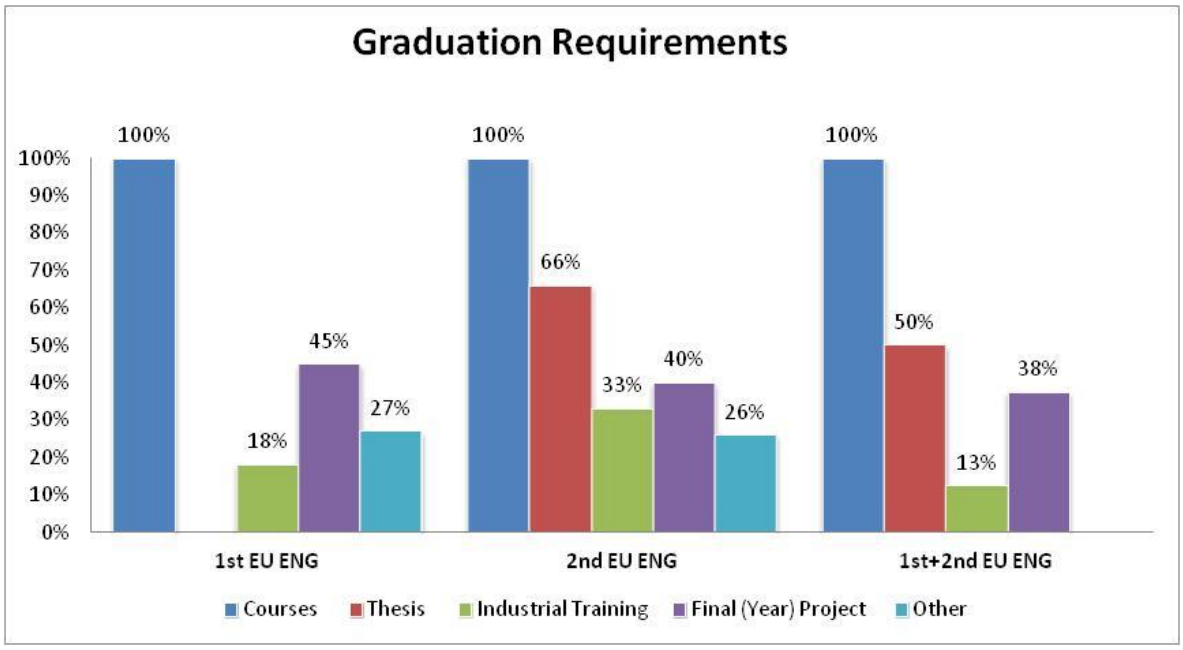


Figure 11 – Graduation Requirements

On the required number of courses and credits (ECTS) per year, the situation is rather harmonized across the three categories of engineering programmes reviewed (Figure 12). With only very few exceptions, most programmes require on average 10-11 courses or the equivalent of 60 ECTS credits per year. For US programmes, the average number of credits is approximately 30 US credits per year (120 US credits for a Bachelor's degree and 30-40 more credits for a Master's degree).

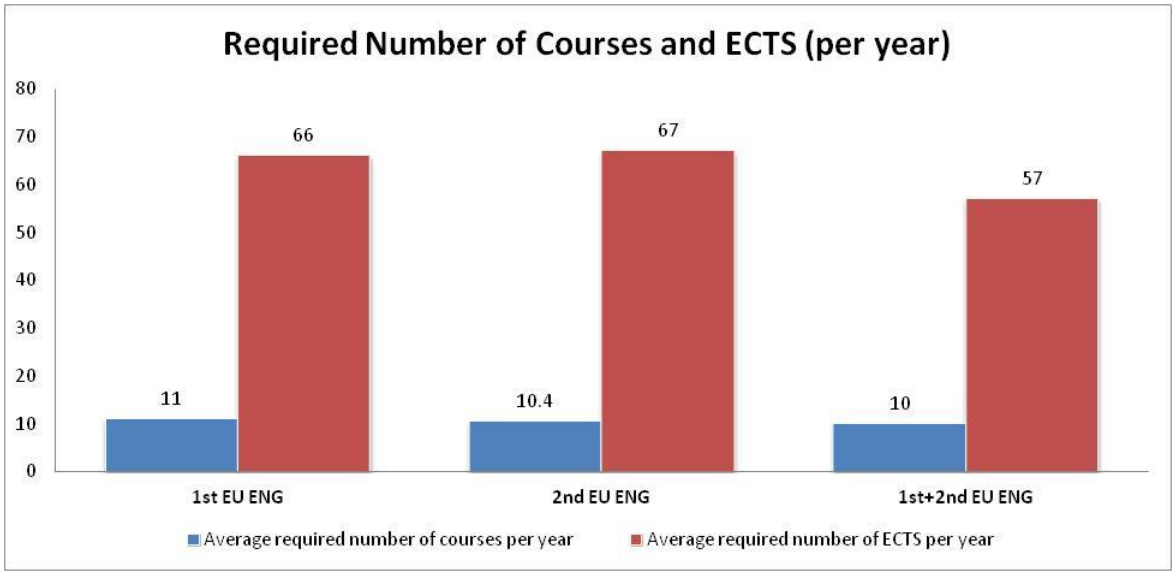


Figure 12 – Average Required Number of Courses & ECTS per year

All categories of engineering programmes – almost all 2nd cycle and MEng programmes and half of the undergraduate programmes – reported a strong engagement in cooperation

activities with the industry. The most typical types of cooperation (Figure 13) were the funding of research projects and internships, as well as various types of financial sponsorship (e.g., programme funding, funding of staff positions, endowments).

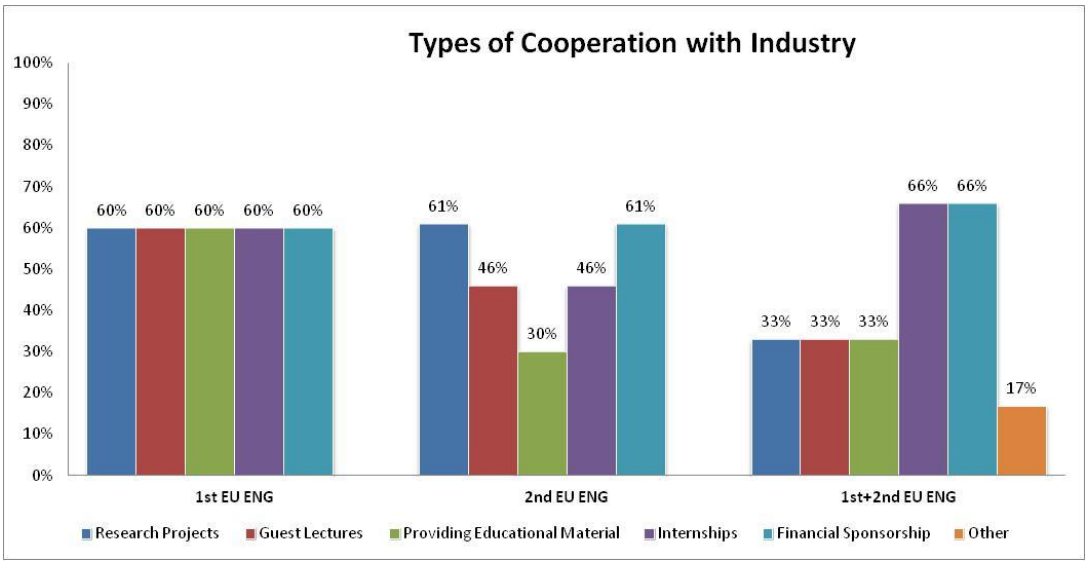


Figure 13 – Types of Cooperation with Industry

An interesting finding of the review was the lack of harmonized accreditation or quality assurance systems and the need of establishing a European-wide academic accreditation system. In some countries (e.g., Italy, Greece), national authorities or bodies establish rules upon which accreditation is granted as long as programmes conform to the rules. In other countries (UK, Portugal), degrees are accredited (and periodically re-confirmed) through an "a posteriori" evaluation process by a professional association or government-appointed body. Among the reviewed programmes, the most typical types of accreditations were those exhibited by UK Universities such as the accreditation by the Royal Aeronautical Society and the Chartered Institute of Logistics and Transport. At the outset, although professional accreditation / licensing is common, academic (programme) accreditation is sparsely offered. Therefore, there seems to be a need for a European-wide academic accreditation system. This system should build on recent initiatives undertaken by the PEGASUS Partnership towards the establishment of a voluntary accreditation system for Aerospace Engineering education in Europe. In addition, it should pursue synergies with other accreditation bodies / associations with special emphasis on: i) the European Network for Accreditation of Engineering Education (ENAEE) offering the EUR-ACE[7] framework, set of standards, and accreditation system for engineering degree programmes at 1st/2nd cycle and ii) the European Association

[7] http://www.enaee.eu/eur-ace-system

for Quality Assurance in Higher Education (ENQA, 2004)[8] offering accreditation models and quality assurance best practices for higher education.

Another interesting feature relates to specialization options offered by engineering programmes. Based on our review, it comes out that almost half of the 2nd EU ENG programmes and one third of the reviewed 1st EU ENG and MEng programmes offer specializations. The most frequently appearing categories of specializations are: Aeronautics, Space, Aerodynamics, Propulsion and Structures, as well as Flight Systems and Mechanics.

Regarding the educational curriculum and course structure/content, despite some differences between countries, there is an evident pattern and common features among the reviewed engineering programmes. For comparative purposes, these are summarized below for full 5-year or 3+2 programmes:

- The first two years are mostly focused on courses related to fundamental sciences (e.g., mathematics, chemistry, physics) or basic/general engineering content (e.g., mechanics, electronic engineering, software engineering). Some aerospace engineering topics may be introduced during the second year.
- The third year, which may also lead to an intermediate (Bachelor's or equivalent) degree, introduces more course modules and topics on aerospace engineering that are complemented by general engineering courses.
- The last two years (fourth and fifth) offer specialized and advanced topics on aerospace engineering along with opportunities for undertaking more research-oriented topics in laboratories and industrial internship or final year project. This provides the student with an opportunity to apply the knowledge and skills acquired through courses to real-life industry problems. Finally, the last two years of highly specialized studies are typically complemented by general management/business courses, financial/economics courses, aeronautical regulation/law courses and other specialized management-related topics, as well as foreign languages.

The logical sequence or dependency relationships among courses, and most importantly, the magnitude of the various course categories (e.g., fundamental sciences, basic/general engineering, aerospace engineering, other general courses, final year project, industrial internship) varies substantially from programme to programme. For example, the industrial internship is often envisaged for the final year of studies, but it can also take place well before (third year) or even not at all. Another notable variation is observed in the magnitude of

[8] http://www.enqa.eu/files/ENQAmodels.pdf

basic/general engineering courses and mainly other general courses, which may range from few courses to a substantial part of the educational curriculum. Furthermore, the profile of a given programme is also affected by the country and the underlying educational system. As a general rule, countries with a strictly regulated and administered educational system (e.g., Italy, France) demonstrate little variation in their programmes' profiles. On the other hand, countries that traditionally exhibited a decentralized educational system (e.g., UK, Germany) show a larger dispersion and diversity in their programmes' curricula. Along the same lines, other countries (e.g., UK) put strong emphasis on the offering of specialized courses on aerospace engineering hence leaving less room for more general or other courses. Finally, the duration and educational format of the courses may also strongly vary ranging from a few weeks duration to several months and from 3 to 12 ECTS.

For the purposes of our analysis here, we have identified 15 categories of courses that are the most representative in aerospace engineering programmes in Europe. The identified categories were based on a similar review of PEGASUS Aerospace Engineering Programmes (PEGASUS Partnership, 2009) and were slightly expanded and adapted in the EDUCAIR context. More specifically, categories 8-10 were added to account for competences of actors/stakeholders (e.g., airports, airlines, ATM/ATC authorities) that are particularly targeted by the EDUCAIR survey. Furthermore, the last two categories include course modules on: i) fundamental sciences (e.g., mathematics, chemistry, physics) or basic/general engineering content (e.g., mechanics, electronic / electrical engineering, software engineering) and ii) other courses on general management/business, financial/economics, aeronautical regulation/law and other specialized management-related courses, e.g., quality management, knowledge management, marketing, human resources, project management, supply chain management (excluding foreign languages). The remaining categories (similar to those used in the PEGASUS review) correspond to more or less specialized aerospace engineering topics that are widely taught in relevant programmes.

1. Aerodynamics, Gas Dynamics, Heat Transfer
2. Structures and Materials
3. Aircraft Design, Subsystems and Integration
4. Rotary Wing Systems and Non-conventional Aircraft
5. Performance, Stability and Control, Flight Mechanics
6. Propulsion and Combustion
7. Production and Maintenance
8. Airport Planning, Design and Operations

9. Airline Operations
10. ATM/ATC
11. Aircraft Operations and Safety
12. Aircraft Navigation, Avionics, Communications
13. Space Engineering and Technology
14. Fundamental Sciences / General Engineering
15. Other

An "average" or "typical" profile of the educational curricula of the reviewed programmes is presented in the figures below for the four types of reviewed programmes in Europe (1st EU ENG, 2nd EU ENG, 1st+2nd EU ENG, 2nd EU MNG). The educational profiles discussed below include both compulsory and elective courses and report in relative terms the percentage of the identified course categories over the total number of ECTS offered in the specific programme. In other words, they provide a measure of magnitude, focus or degree of specialization offered by the reviewed programmes in the selected course categories / topics.

It is clear that fundamental sciences and general engineering represents by far the dominant category in 1st cycle engineering and MEng programmes since a large number of such courses are typically offered as a background or introduction to engineering studies during the first two years. Furthermore, the "Other" category (e.g., general management/business, financial/economics, law, marketing, human resources) is comparably represented at all engineering programmes. Specialized aerospace/aeronautical engineering courses (especially Categories 1-7) are also similarly weighted in all cycles of engineering programmes. A notable exception is observed in 2nd cycle of EU Management AAT programmes in which the "Other" category normally represents the dominant category in the absence of engineering courses. Finally, it is important to underline the fact that airport, airline, and ATM/ATC-related courses are hardly available (at least on a stand-alone basis) in engineering programmes. On the contrary, the aforementioned categories represent almost half of the educational offering of 2nd cycle EU Management AAT programmes. This observation reveals the strong complementarity between relevant engineering and management programmes in AAT and justifies the study path of several engineers pursuing a "complementary" management degree after completing their 1st cycle engineering degree.

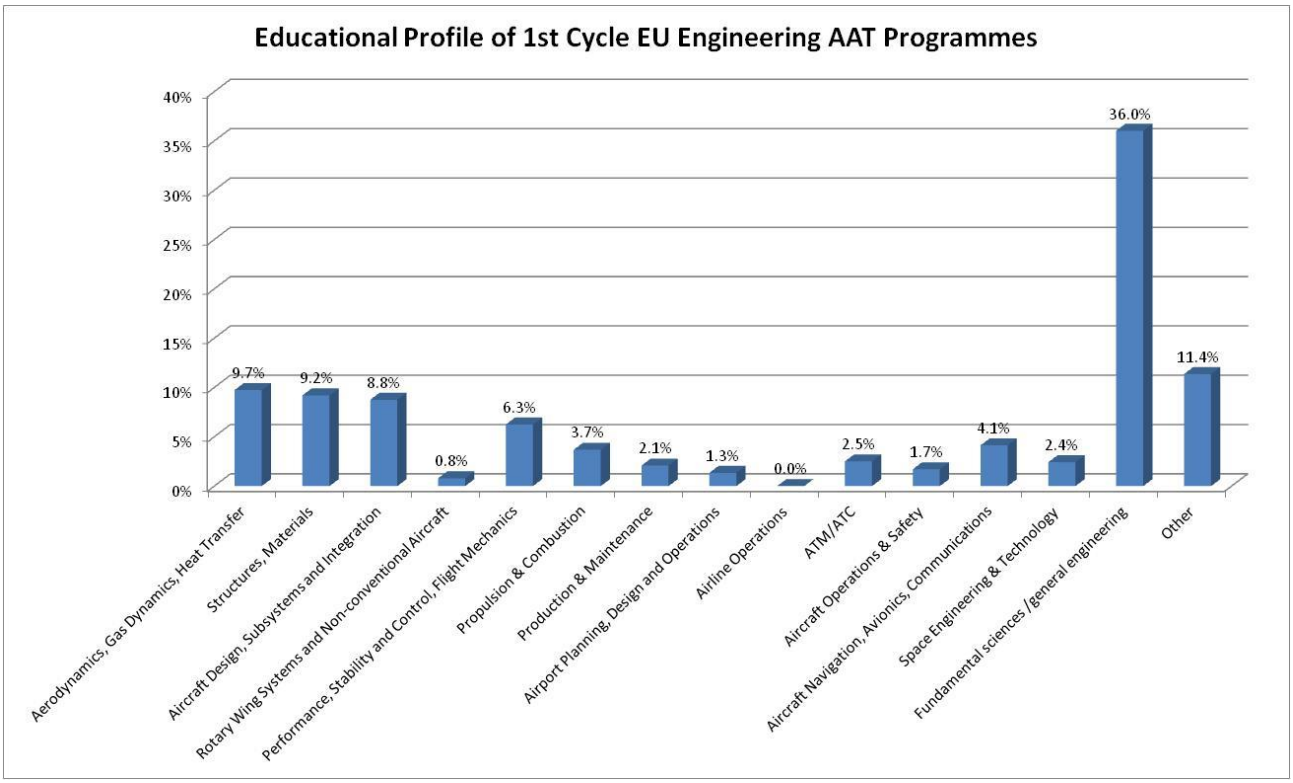


Figure 14 – Educational Profile of 1st Cycle EU Engineering AAT Programmes

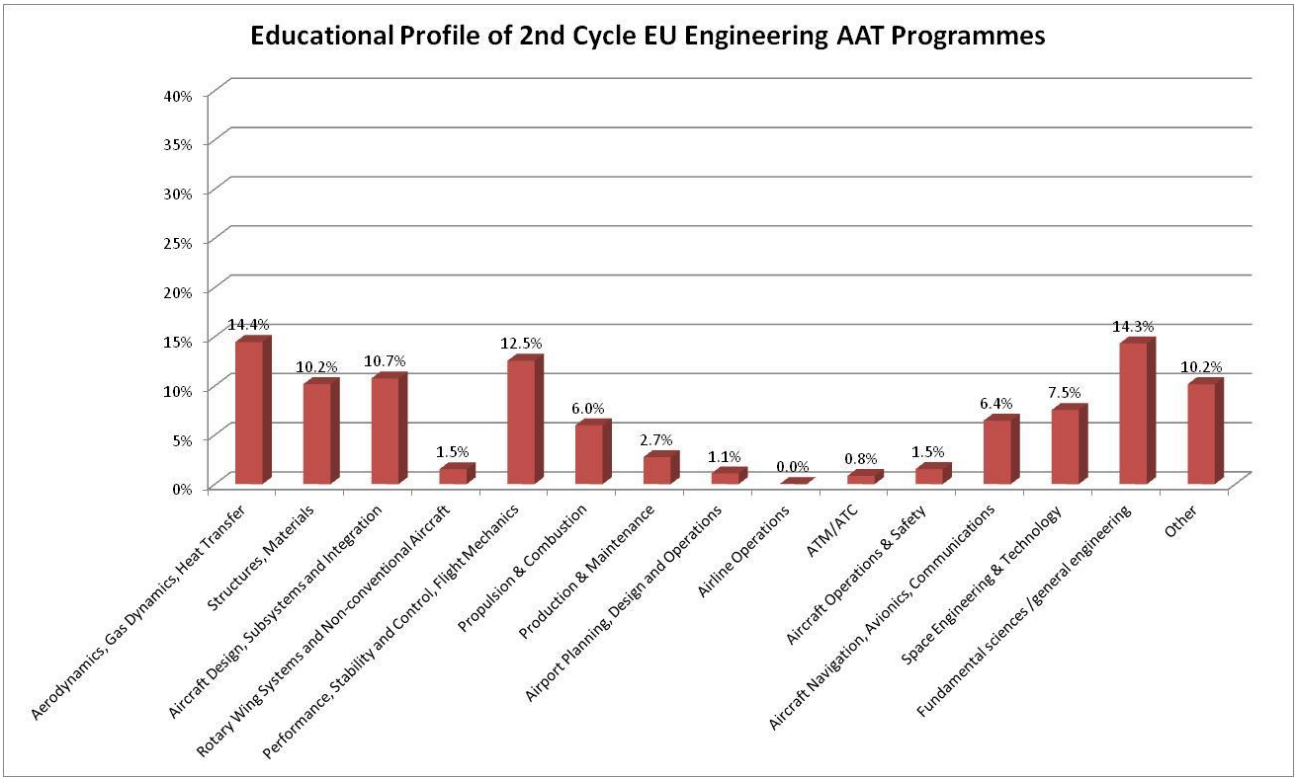


Figure 15 – Educational Profile of 2nd Cycle EU Engineering AAT Programmes

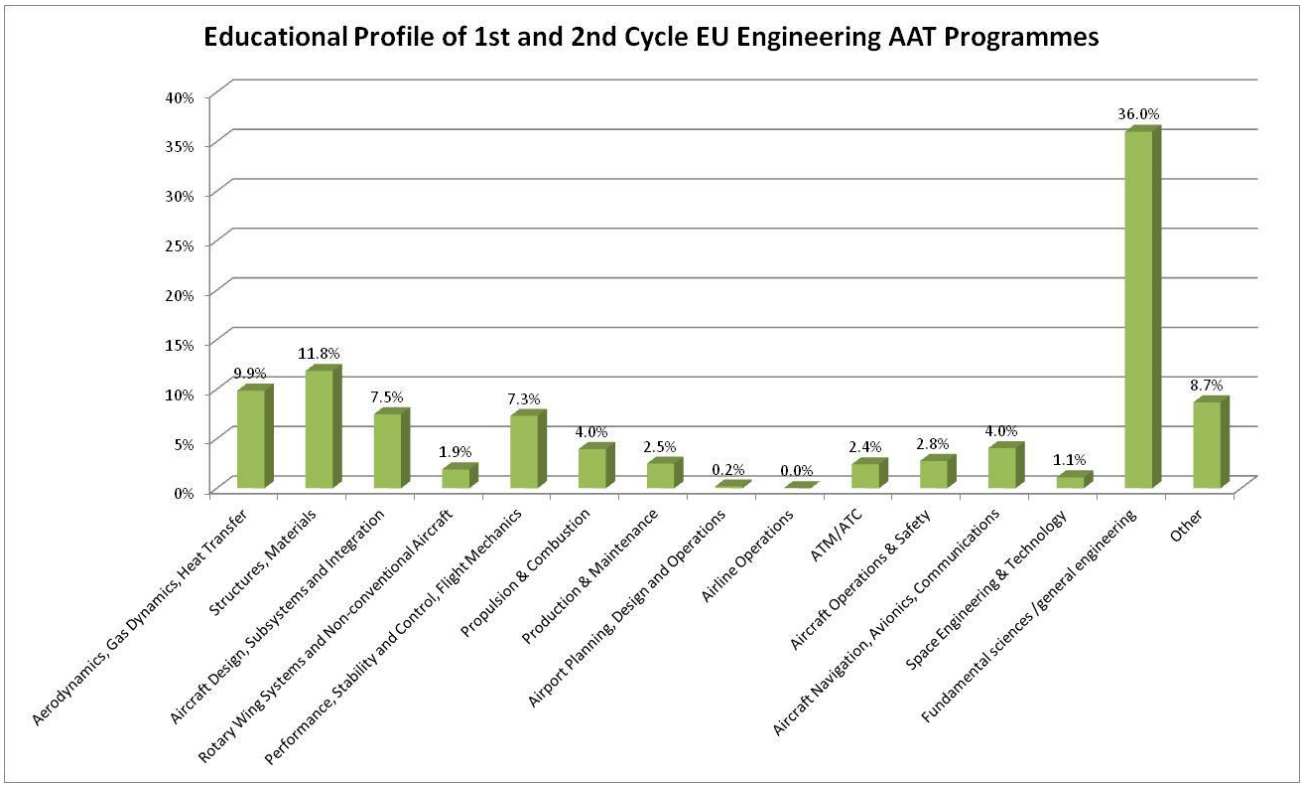


Figure 16 – Educational Profile of 1st and 2nd Cycle EU Engineering AAT Programmes

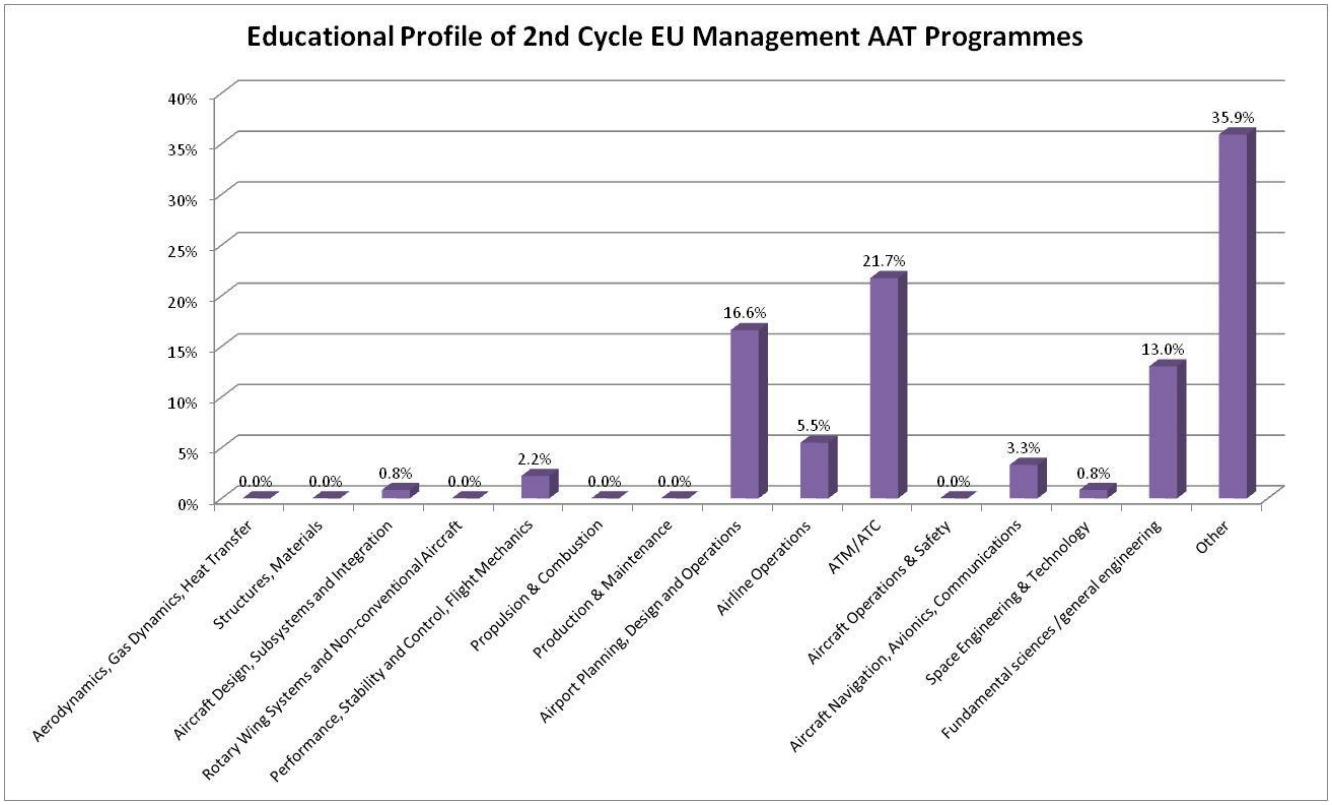


Figure 17 – Educational Profile of 2nd Cycle EU Management AAT Programmes

In conclusion, this analysis is not intended to include a comprehensive list of all course topics offered or to prescribe the "best mix / educational offering"; it rather attempts to develop a typical profile of the existing educational offering and identify course categories / areas that are over or under-represented. The latter information can be further processed in WP8 in order to assess the degree to which the existing educational offering can potentially fulfil the competences required by the industry. Furthermore, despite some differences between countries or programmes, there are some clear similarities and common features among the reviewed engineering programmes. These are mainly related to the temporal structure of studies and the main course categories offered in respective years of studies. Finally, most of the programmes provide - to varying degrees though - the option to their students to freely select a certain number of courses (or ECTS) from the entire course catalogue of the programme, the University or even other cooperating Universities (e.g., PEGASUS partner). This provides ample opportunities for students to shape their own, customized / individual profile and build their own portfolio of competences especially through the selection of elective courses at home or other foreign partner University. The diversity of student profiles contributes to increasing the flexibility and mobility of students and to a more spherical coverage of specialized industry needs. On the other hand, it makes difficult to assess and compare the educational offering of programmes or Universities since their educational "output" (various student profiles) is already highly customized.

4.3 Review of LLL/CPD Programmes

Lifelong learning (LLL) is the "ongoing, voluntary, and self-motivated" pursuit of knowledge for either personal or professional reasons (Department of Education and Science, 2000). Therefore, it not only enhances social inclusion, active citizenship and personal development, but also competitiveness and employability (European Commission, 2006). On the other hand, Continuing Professional Development (CPD) or Continuing Professional Education (CPE) is the means by which people maintain their knowledge and skills related to their professional lives. They can be tailor-made and directly targeted to the employees and needs of the industry or a certain company. They also include vocational education. From now on, we jointly recall CPD and CPE as CPD.

In this section both LLL and CPD programmes will be covered. The difference between LLL and CPD is defined by the inherent requirements to obtain the degree of the respective training or programme. If there is a training recurrence or repetition necessity towards the

knowledge delivery or update (in order to remain current), the training is to be seen as an LLL training or programme, otherwise it is a CPD programme.

The objective of this section is to identify and review the current offer (supply) of educational curricula of vocational and professional or corporate programmes (CPD) as well as Lifelong Learning (LLL) programmes in air transport and aeronautics. The reviewed curricula/programmes will address a large spectrum of educational, both management and engineering-related orientations / specializations in air transport and aeronautics such as programmes with:

- pure aerospace engineering content,
- infrastructure, facilitation and maintenance content
- air transport management background.

In order to collect information related to the current offer/supply of educational curricula/programmes, a structured review template (Appendix 8.2) was developed for a desktop review aiming to collect information related to the identified curricula and programmes. The review template was structured into three parts. The first part contained general questions aiming to specify the identity of the reviewer organization / partner and individual expert along with the corresponding review assignment within EDUCAIR/WP4. The second part addressed the training offer, structure and the various constituents of the programme under review, while the third part included questions related to generic aspects / issues of the reviewed programme.

The terms of the actual competencies acquired by the participants in relation to what is offered by the educational programmes and what is actually required in their working daily activities were assessed for a selected number of programmes. This will be used as input for the assessment of Gaps 1 and 3 (discrepancies between the needs of the respective stakeholders) in WP8.

The subsequent section introduces the identified LLL and CPD programmes offered in Europe, including their scoping/listing criteria. In order to make a desktop review of the current LLL/CPD offer/supply, a criteria analysis for programme selection was set-up, making the desktop review and analysis possible within the scope of this project. The selection criteria and the list of reviewed LLL/CPD programmes are discussed in Sections 4.3.2 and 4.3.3, respectively. Finally, Section 4.3.4 presents the final synthesis and conclusions drawn from the review of the selected programmes.

4.3.1 List of Identified LLL/CPD Programmes

Table 11 shows the summarized results of the desk research performed towards identifying relevant LLL and CPD programmes in Europe, whereas Appendix 8.4 provides more detailed information per programme. The list of LLL/CPD programmes was set-up by using World Wide Web internet sources, after which a validation of industry experts took place to check the list for completeness and fulfilment of the generated criteria. It should be stressed that this list is to be considered as an attempt to identify most relevant programmes rather than providing a complete and exhaustive repository of LLL/CPD programmes.

Table 11: LLL/CPD Programmes in Europe (Organization and Title)

Organization	Type of Programme	Title
Belgian Flight Group	Aircraft Maintenance Mechanic	Aviation Maintenance
IATA (International Air Transport Association)	Airport Training (e-learning)	Airport Operations
IATA (International Air Transport Association)	ATM Training (e-learning)	Airport Ramp Services
IATA (International Air Transport Association)	ATM Training (e-learning)	Aviation Security Awareness
IATA (International Air Transport Association)	ATM Training (e-learning)	Minimum Navigation Performance Specification (MNPS)
IATA (International Air Transport Association)	Airport Training (e-learning)	Basic Airside Safety
IATA (International Air Transport Association)	Airport Training (e-learning)	Pre-flight planning
IATA (International Air Transport Association)	CAA Training (e-learning)	Carbon markets
DLR/ESA (German Aerospace Center/ European Space Agency)	Research-university alliances	Radar Remote Sensing Technology and Environmental Applications
ECATA (European Consortium for Advanced Training in Aerospace)	Industry-university alliances	Aerospace Business Integration
Airbus	Industry	Flight & cabin crew training
Airbus	Industry	Maintenance training
Airbus	Industry	Avionics & simulation
Airbussiness Academy (Airbus subsidiary)	CPD	Air Cargo Market
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Asset Management
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Cabin
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Contracts
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Customisation and Standardisation
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Economics Seminar
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Evaluation
Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Financing for Non-financiers

Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Operating Lease Market
Airbussiness Academy (Airbus subsidiary)	CPD	Airline Fleet Planning
Airbussiness Academy (Airbus subsidiary)	CPD	Airline Marketing
Airbussiness Academy (Airbus subsidiary)	CPD	Airline Revenue Management
Airbussiness Academy (Airbus subsidiary)	CPD	Commercial Aspects of Aircraft Maintenance
Airbussiness Academy (Airbus subsidiary)	CPD	Customer Awareness in Air Transport
Airbussiness Academy (Airbus subsidiary)	CPD	New Perspectives in Aircraft Finance
Airbussiness Academy (Airbus subsidiary)	CPD	Supporting the Aircraft
ENAC (École Nationale de l'Aviation Civile)	University	Organisation, Fonctionnement et Automatisation
ENAC (École Nationale de l'Aviation Civile)	University	Information de vol
ENAC (École Nationale de l'Aviation Civile)	University	Conception de procédures
ENAC (École Nationale de l'Aviation Civile)	University	Satellite-based Communication, Navigation & Surveillance
ENAC (École Nationale de l'Aviation Civile)	University	Architecture systèmes
ENAC (École Nationale de l'Aviation Civile)	University	Sécurité, audit
ENAC (École Nationale de l'Aviation Civile)	University	Avionique et ATM
ENAC (École Nationale de l'Aviation Civile)	University	Management du transport aérien
ENAC (École Nationale de l'Aviation Civile)	University	Exploitation aéronautique
ENAC (École Nationale de l'Aviation Civile)	University	Navigabilité des aéronefs
ENAC (École Nationale de l'Aviation Civile)	University	Management aéroportuaire
ENAC (École Nationale de l'Aviation Civile)	University	Sûreté
Nayak	Aircraft Maintenance Mechanic	Technical Training
Lufthansa	Industry-university alliances	Business Administration
Lufthansa	Industry-university alliances	Informatics/Business Informatics
Lufthansa	Industry-university alliances	Engineering
Lufthansa Technical Training	Industry	Aviation English
Lufthansa Technical Training	Industry	Aeronautical Engineering
Lufthansa Technical Training	Industry	Aviation Management
DLR		Space Operations and Astronaut Training
DLR	Short course	Spacecraft Operations Course
DLR	Short course	Particle Image Velocimetry
DLR	Short course	Direct Numerical Simulations (DNS) and Large Eddy Simulations (LES)
DLR	Short course	Application of pressure sensitive paint
University of Wildau	University	Master in Aviation Management (part-time)
Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline, Airport and Aircraft Finance

Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline Commercial Perspectives
Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline Management Simulation
Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	EU Emission Trading Scheme (ETS)
Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Fleet Management and Maintenance
Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Strategic Airline Management
EASTO (European Aviation Safety Training Organization: JAA-TO, the International Institute of Air and Space Law of the University of Leiden, the Dutch National Aerospace Laboratory (NLR), the Netherlands Aviation College (ROC/NLC), ADSE Consulting and Engineering, and CAA-Belgium)	Industry-university alliances	Aviation safety training courses
SpaceTech	Delfttoptech/DUT	Post Graduate SpaceTech
Singapore Aviation Academy/INSEAD	Industry-university alliances	Aviation Leaders Programme in Advanced Management (ALPAM)
Stanford/IATA	Industry-university alliances	Stanford - IATA Aviation Management Certificate
Harvard/IATA	Industry-university alliances	IATA-Harvard Leadership & Management Diploma in Aviation
Nanyang Technological University (NTU)/IATA	Industry-university alliances	IATA Nanyang Advanced Management Programme
University of Geneva/IATA	Industry-university alliances	Aviation Management - IATA/University of Geneva
Cranfield University	CPD and short courses	Advanced computation methods and simulations
Cranfield University	CPD and short courses	Airborne vehicle and systems
Cranfield University	CPD and short courses	Aviation and the environment
Cranfield University	CPD and short courses	Aviation management and operations
Cranfield University	CPD and short courses	Management and leadership
Cranfield University	CPD and short courses	Propulsion
Cranfield University	CPD and short courses	Space systems and applications
Cranfield University	CPD and short courses	Structures and materials
Emirates College/Coventry University (UK)	Industry-university alliances	Higher National Diploma in Aerospace Engineering
Emirates College/Coventry University (UK)	Industry-university alliances	Higher National Diploma in Avionics Engineering
Emirates College/Coventry University (UK)	Industry-university alliances	Higher National Diploma in Electronics Engineering and Computing

Emirates College/Coventry University (UK)	Industry-university alliances	Higher National Diploma in Computing Software Development
Emirates College/Coventry University (UK)	Industry-university alliances	Higher National Diploma in Business Management
Civil Aviation Authorities UK	Industry	Maintenance training
AVISA Aviation Safety Systems Ltd	Industry	Quality Assurance and Maintenance
London City University	Masters of Science	Air Transport Management
London City University	Masters of Science	Air Safety Management
London City University	Masters of Science	Aircraft Maintenance Management
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Accident Investigation and Prevention
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aeronautical Information Services
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aeronautical Meteorological Services
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Environment
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Air Traffic Control
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Air Transport
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aircraft Maintenance and Airworthiness
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Airport Engineering and Maintenance
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Fire Fighting and Search and Rescue Services
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aviation Management
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aviation Security
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aeronautical Communications and Navaids Maintenance
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Aeronautical Communications Operations
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Machine Readable Travel Documents
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Safety Management
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Training Technology ins
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Flight Operations Services PIL
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Flight Calibration
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Airline Cabin and Support Services

International Civil Aviation Organization (ICAO)	Industry-Association alliances	Language Training
International Civil Aviation Organization (ICAO)	Industry-Association alliances	Civil Aviation Training Courses
Airports Council International (ACI)	Industry-Association alliances	Airport Executive Leadership Programme
Airports Council International (ACI)	Global Safety Network Training	Global ACI-ICAO Airport Management Professional Accreditation Programme (AMPAP)
Airports Council International (ACI)	Global Safety Network Training	Air Transportation System
Airports Council International (ACI)	Global Safety Network Training	Airport Commercial and Financial Management
Airports Council International (ACI)	Global Safety Network Training	Airport Operations, Safety and Security
Airports Council International (ACI)	Global Safety Network Training	Airport Master Planning, Development and Environmental Management
Airports Council International (ACI)	Global Safety Network Training	Safety Management Systems
Airports Council International (ACI)	Global Safety Network Training	Airside Safety and Operations
Airports Council International (ACI)	Global Safety Network Training	Working with Annex 14
Airports Council International (ACI)	Global Safety Network Training	Aerodrome Safety Compliance and Auditing
Airports Council International (ACI)	Global Safety Network Training	Airside Operations
Airports Council International (ACI)	Airport Operational Dynamics	Airport Business Dynamics
Airports Council International (ACI)	Airport Operational Dynamics	Airport Terminal and Landside Operation
Airports Council International (ACI)	Airport Operational Dynamics	Accident and Incident Investigation
Airports Council International (ACI)	Professional certificate course (safety)	ACI/ICAO Aerodrome Certification
Airports Council International (ACI)	Professional certificate course (safety)	Airport Safety Management Systems Implementation
Airports Council International (ACI)	Professional certificate course (safety)	Airside Safety and Operations
Airports Council International (ACI)	Professional certificate course (safety)	Apron Management
Airports Council International (ACI)	Professional certificate course (safety)	Collaborative Decision Making (CDM)
Airports Council International (ACI)	Professional certificate course (safety)	Human Factors for Airport Managers
Airports Council International (ACI)	Professional certificate course (safety)	Runway Incursion Awareness and Prevention
Airports Council International (ACI)	Professional certificate course (safety)	Airport Security
Airports Council International (ACI)	Professional certificate course (security)	Baggage Screening: Operational and Image Analysis

Airports Council International (ACI)	Professional certificate course (security)	Developing a Customer Service Culture at Airports: Measuring and Benchmarking the results
Airports Council International (ACI)	Professional certificate course (facilitation)	Managing Service Quality at Airports
Airports Council International (ACI)	Professional certificate course (facilitation)	Passengers with Reduced Mobility (PRM) Workshop
Airports Council International (ACI)	Professional certificate course (facilitation)	ACI/ICAO Airport User Charges
Airports Council International (ACI)	Professional certificate course (economics/commercial)	Airline Management for Airport Professionals
Airports Council International (ACI)	Professional certificate course (economics/commercial)	Airport Concession Management
Airports Council International (ACI)	Professional certificate course (economics/commercial)	Airport Non-Aeronautical Revenues
Airports Council International (ACI)	Professional certificate course (economics/commercial)	Airport Route Development and Marketing
Airports Council International (ACI)	Professional certificate course (economics/commercial)	EU Funds and Airport Financing
Airports Council International (ACI)	Professional certificate course (economics/commercial)	Airport Carbon Management
Airports Council International (ACI)	Professional certificate course (environment)	Airport Environment Management
Airports Council International (ACI)	Professional certificate course (environment)	Global ACI/ICAO AMPAP Elective on Airport Environment Management
Airports Council International (ACI)	Professional certificate course (environment)	Air Traffic Forecasting
Airports Council International (ACI)	Professional certificate course (airports)	Airport Communication and Public Relations
Airports Council International (ACI)	Professional certificate course (environment)	Airport Master Planning
Airports Council International (ACI)	Professional certificate course (environment)	EU Regulations for Airports
Airports Council International (ACI)	Professional certificate course (environment)	Airport Strategic Human Resources Management
Airports Council International (ACI)	Professional certificate course (human Resource)	Airport Project Management Essentials
Airports Council International (ACI)	Professional certificate course (human Resource)	Airport Enterprise Risk Management
Airports Council International (ACI)	Professional certificate course (human Resource)	Airside Safety Awareness Package
Airports Council International (ACI)	Operations and Regulatory Courses (safety)	Human Factors Awareness Training
Airports Council International (ACI)	Operations and Regulatory Courses (safety)	Dangerous Goods Awareness for Passenger Handling Personnel (Category 9 per ICAO Technical Instructions)

IATA (International Air Transport Association)	Operations and Regulatory Courses (safety)	Air Cargo Operations Essentials
IATA (International Air Transport Association)	Airline Training	Air Transportation Management
IATA (International Air Transport Association)	Airline Training	Air Waybill Rating Fundamentals
IATA (International Air Transport Association)	Airline Training	Aircraft Weight and Balance
IATA (International Air Transport Association)	Airline Training	Airline Business Foundations
IATA (International Air Transport Association)	Airline Training	Airline Passenger Services
IATA (International Air Transport Association)	Airline Training	Airport Customer Service
IATA (International Air Transport Association)	Airline Training	Airport Slots and Scheduling
IATA (International Air Transport Association)	Airline Training	Airside Operations - Safety Compliance
IATA (International Air Transport Association)	Airline Training	Biojet Fuel Workshop
IATA (International Air Transport Association)	Airline Training	Documentation Control and Passenger Assessment
IATA (International Air Transport Association)	Airline Training	Foundation of Risk Management
IATA (International Air Transport Association)	Airline Training	Human Factors in Aviation
IATA (International Air Transport Association)	Airline Training	In-flight Security
IATA (International Air Transport Association)	Airline Training	IOSA Auditor Training
IATA (International Air Transport Association)	Airline Training	Medical Issues in Aviation
IATA (International Air Transport Association)	Airline Training	Network, Fleet and Schedule Planning
IATA (International Air Transport Association)	Airline Training	Passenger Fares and Ticketing
IATA (International Air Transport Association)	Airline Training	Passenger Proration
IATA (International Air Transport Association)	Airline Training	Quality Management Systems (QMS) for Airlines
IATA (International Air Transport Association)	Airline Training	Revenue Management
IATA (International Air Transport Association)	Airline Training	Safety Management Systems for Civil Aviation
IATA (International Air Transport Association)	Airline Training	Security Management Systems - SeMS
IATA (International Air Transport Association)	Airline Training	Station Operations Control
IATA (International Air Transport Association)	Airline Training	Temperature Sensitive Cargo Handling
IATA (International Air Transport Association)	Airline Training	Radios and Communications

IATA (International Air Transport Association)	ATM Training	AIS
IATA (International Air Transport Association)	ATM Training	Introduction to Safety Management Systems (SMS)
IATA (International Air Transport Association)	ATM Training	Quality Management Systems for CAAs and Air Navigation Service Providers
IATA (International Air Transport Association)	ATM Training	Airport Security Awareness
IATA (International Air Transport Association)	Airport Training	Internal Audit for Ground Serviced Providers
IATA (International Air Transport Association)	Airport Training	Managing the Safety Oversight Function
IATA (International Air Transport Association)	CAA Training	Civil Aviation Management
IATA (International Air Transport Association)	CAA Training	Air Waybill Rating Fundamentals
IATA (International Air Transport Association)	Ground handling Training	Business Aviation and FBO Ground Services
IATA (International Air Transport Association)	Ground handling Training	Cargo Skills and Procedures
IATA (International Air Transport Association)	Ground handling Training	Dangerous Goods Awareness
IATA (International Air Transport Association)	Ground handling Training	IATA Air Cargo Rating
IATA (International Air Transport Association)	Ground handling Training	IATA Cargo Introductory Course
IATA (International Air Transport Association)	Ground handling Training	IATA Electronic Airwaybill (e-AWB)
IATA (International Air Transport Association)	Ground handling Training	International Cargo Operations and Documentation
IATA (International Air Transport Association)	Ground handling Training	ULD Handling Awareness

The list in Appendix 8.4 provides information on:

- The **Country** in which the programme is delivered
- The **Organization** which delivers the LLL/CPD programme
- How the programme can be characterized by projecting the **Type of programme**. The Type of programme is defined based on the programme structure and major characteristics.
- The **Title of the programme**, given by the organization
- The type of content delivered (aerospace engineering; infrastructural, facilitating and maintenance or air transport management)

The following criteria were defined to pursue a list which is focused and manageable. If a programme's characteristics, found through research, did not meet these criteria it was left out of the LLL/CPD list.

- The geographical coverage of the review was set to EU27. Where applicable and available, comparative findings and examples from other regions were considered.
- Only programmes explicitly leading to some licensing or programme certificate in the air transport sector have been examined. Generic programmes were not considered.
- Programmes of organizations delivering more than 20 programmes are enlisted based on their relevance (according to these criteria) and their title in which the programme is collected together with comparable programmes.
- Programmes exhibiting regularity (offered on a regular basis) have been targeted.
- Programmes clearly demonstrating an international dimension were primarily targeted as compared to dedicated (strictly national) programmes offered by a national civil aviation authorities, e.g. Air Traffic Controller licensing; consequentially all European Air navigation and pilot vocational trainings are not taken into account. Due to a high availability of these programmes and the fact that ICAO standards and recommended practices drive the programme content, it is presumed that these programmes do not drive a discrepancy between the demands of the respective stakeholders in WP8.
- The list should propose a spread of programme types according to the three focal professional groups:
  - pure aerospace engineering content,
  - infrastructure, facilitation and maintenance content
  - air transport management background.

4.3.2 Selection Criteria for the LLL/CPD Programmes to be Reviewed

As LLL/CPD stakeholders are not explicitly targeted by the stakeholder online survey process, a review of a subset of the LLL/CPD programmes (in addition to the review in WP4) is performed in this section. The criteria for programmes to be selected as part of the review subset are set-up here.

The selection of the relevant programmes for review was based on the following criteria:

- a spread towards the type of programme, therefore programmes offered by university-industry alliances, key industry associations (e.g., IATA, ACI, ICAO) or individual industry actors (e.g., LFH, Airbus, Air France, Emirates) will be selected
- a spread of the subjects related to the three focal professional groups,
- maximum geographical coverage (including relevant U.S. experiences), including both national and international programmes

From the resulting list, the most representative programmes for the respective industry are chosen and discussed in the next section.

4.3.3 List of Reviewed LLL/CPD Programmes

The next table reflects the subset of the LLL/CPD, as a result of the evaluation of the entire LLL/CPD list in Appendix 8.4 by means of the criteria mentioned in the previous section. The programmes listed in Table 12 have been eventually reviewed. The list has been validated by experts and said to be a reasonable reflection of the complete list in Appendix 8.4.

Table 12: Reviewed LLL/CPD Programmes in Europe (Country of delivery, organization and title)

Country	Organization	Title
France	ECATA	Aerospace Business Integration
	Airbus	Maintenance training
Germany	Lufthansa Technical Training	Aeronautical Engineering
Switzerland	Stanford/IATA	Stanford - IATA Aviation Management Certificate
	Harvard/IATA	IATA-Harvard Leadership & Management Diploma in Aviation
UK	Cranfield	Structures and materials
	Emirates college/Coventry Univ.	Higher National Diploma in Aerospace Engineering
World	ACI	Airport Operations, Safety and Security
World	IATA	Air Transportation Management

4.3.4 Key Findings of the Review of LLL/CPD Programmes

The structured review template (Appendix 8.2) resulted in reviews of the selected programmes. The following conclusion towards similarities, differences, typical structure, main subjects of studies or other interesting points can be highlighted. Table 13 and Table 14 summarize the results for questions 11, 12, 15, 18-20, 23 25 and 27 from the review template. The results are described in the following sections.

Table 13: Tabular Summary of Question 19 (of Review Template of LLL/CPD Programmes)

Programme	Targeted Function
ECATA	Young high-potential engineers, scientists and researchers
Airbus	-Technical and non-technical managers and other support personnel as well as technical personnel with through flight and line maintenance activities. -Maintenance Certifying Technicians - Mechanics, who are holders of a basic license or equivalent and who seek type qualification on the aircraft.
Lufthansa Technical Training	-EASA Part-66 category B1/B2 or other maintenance staff; middle and higher management staff, engineers in aviation as well as employees in the direct working environment of the aircraft type.
Stanford/IATA	-New or experienced managers coming into aviation from another industry -Recently promoted employees working within the industry Individuals who wish to pursue other airline/airport/civil aviation/management courses and wish to obtain essential knowledge to further their studies -Individuals wishing to enhance their understanding of the air transportation environment
Harvard/IATA	-Supervisors and managers -Anyone wishing to pursue a management careers across aviation, travel and tourism or cargo industry sectors Anyone wishing to upgrade their skills and competencies
Cranfield	-Suitable for stress engineers, analysts and research engineers, responsible senior managers and technical programme managers, airworthiness and certification engineers and maintenance and repair engineers -The course is intended for new members of aircraft stress offices who may have been recruited from other departments, or from other branches of engineering. -The course would be suitable for new and experienced engineers and designers in the field of composites wishing to gain a sound knowledge base of the mechanics of composite materials and to gain hands-on experience of the analysis methods and procedures pertaining to actual composite structural elements.
Emirates College/ Coventry University	N/A
ACI	-Airport executives -Management position within a civil airport organization

Table 14: Tabular Summary of Questions 11, 12, 15, 18, 20, 23, 25 and 27 (of Review Template of LLL/CPD Programmes)

	Requirements for obtaining the degree					Program structure							Selection criteria										Industry								Courses/ECTS req.	
	Attendance	Exam	Industrial exercise	Pre-course work	Other	Less than 1 week	1 week	2 weeks	12 weeks	1 year or 2 years full-time	Other	Students are annually enrolled	Exams	GPA (from previous cycle studies)	Interview(s)	Motivation letter	Recommendation letter(s)	Qualifications test(s)	Certificate(s) of Language(s)	Working experience (out of the industry)	Working experience (in the industry)	Other	Airline	Airport	Manufacturing	Maintenance	Aviation supplier	Consultant	Regulator	Other	Courses	ECTS
ECATA	X		X							X		20				X									X	X					>300hr	N/A
Airbus	X	X			X						X	12	X												X	X					16-21	N/A
Lufthansa Technical Training	X	X									X	16	X										X								N/A	N/A
Stanford/IATA		X			X						X	?										X	X	X	X	X	X	X	X		6+2/yr	N/A
Harvard/IATA		X			X						X	220								X	X		X	X	X	X	X	X	X		11	N/A
Cranfield						X	X	X				?										X			X	X	X	X	X		1	N/A
Emirates college/Coventry Univ.										X		?		X					X			X			X	X	X	X	X		19	N/A
ACI		X			X						X	?										X		X							1	N/A

4.3.4.1 Accreditation Labels / Certifications

There is no uniform certification or accreditation for LLL/CPD programmes. Besides maintenance training (which is based on international legislation), organizations are seeking different methods for international accreditation. Cranfield University's courses are accredited for instance by the "Institution of Mechanical Engineers" and the "Royal Aeronautical Society", two leading academic institutions in the UK. Whereas the joined IATA/Stanford LLL delivery proposes a totally new certificate: the "Certified Aviation Management Professional (AvMP)" which is accredited by both partners itself.

Accreditation varies substantially for each programme, and hence the overall quality of the educational offering. Basis of this variation are national accreditation bodies, because they lack of a standardized and internationally accepted accreditation. Throughout Europe multiple attempts are made to ensure comparability in the standards and quality of higher education qualifications (Bologna process) though there is no automatic EU-wide recognition of academic diplomas.

The only programmes which are accredited and accordingly accepted throughout Europe, as such, are vocational programmes for maintenance, crew and air navigation, which are set-up in accordance with European training standard EASA Part-147 (e.g. Lufthansa Technical Training).

ICAO ensures higher training standards for aviation professionals through the TRAINAIR Program. As ICAO envisions that civil aviation training needs are evolving accordingly, where the necessity tends to exist for standardized training and practices, it is responding by enhancing the TRAINAIR programme. The ICAO programme provides support for new and existing aviation training centers via technical expertise, resources, and quality oversight. This results in a network of ICAO TRAINAIR PLUS Centres meeting the standards of the programme (ICAO, 2012).

Branding and accreditation lie close to each other, as such that a programme can have no accreditation, although it is perceived to deliver highly qualitative programmes because of the inherent organizations brand. Universities have this brand from history but are also based on internal national accreditation. New programmes (IATA E-learning and Middle-East University programmes) therefore try to generate a competitive advantage in making

academic/industrial liaisons or joint ventures in order to virtually accredit or increase the perception of quality of the new respective programme in a cost efficient way.

4.3.4.2 Main Subjects of Studies & Typical Structure

Short courses have focused topics and subjects of study, longer programmes (>1 year) show a mix of subjects (soft and hard skills), besides the EASA certified programmes e.g. maintenance. E-learning programmes show also a mix of hard and soft skills answering a demand for soft and hard skills delivery in a short course period.

Typically LLL/CPD programmes have a short length (1 week or less) when the courses cover a single topic. Organizations have set-up their courses accordingly as employees are mostly not allowed or available to attend a course for a period of more than one week or so. On the other hand, programmes which result in an official EASA accredited diploma exist out of multiple short courses (20 on average) with a length of 1 week or less. The programmes which result in a national accredited academic degree project a length of 1 year or more, these programmes are mostly not full-time, they require a specific in class attendance per month dependent per programme. New E-learning programmes like the Harvard and Stanford IATA model do not require attendance; though they show the same amount of expected study time to receive a full degree. E-learning programmes exist out of 6-11 small courses.

Looking at the knowledge platform used by the different programmes, aerospace engineering LLL/CPD programmes use research or academic knowledge, whereas the other types of programme are clearly based on industry experience.

A clear differentiation can be remarked by means of the degree/certificate requirements respective to the reviewed programmes, by means of the E-learning and the traditional in-class programmes. Required attendance and an exam is characterizing the requirements for the traditional programmes were only digital exams are the basis of the E-learning programmes. An E-learning programme can be done when and where the participant wants according to his agenda and time, therefore saving travel costs. Accordingly larger economies of scale can be effectuated in delivering E-learning programmes receiving more participants. Traditional courses are looking for an optimal participant level of around 12- 20 taking into account the in-class interaction and the financial break-even point.

4.3.4.3 Targeted Audience & Recruitment Criteria

Generally professional courses show low level criteria to enter a respective programme, trying to enlarge the potential market for the specific LLL/CPD programmes and decrease the financial break-even point. Consequently, most programmes show a high spread of targeted participants, some programmes are inherently focused due to the subject delivered and the targeted audience (e.g., Airbus: maintenance programme for maintenance employees).

4.3.4.4 Areas of Competences Developed by Existing LLL/CPD Programmes

This concluding chapter gives a final synthesis and analysis of the competences developed by the LLL/CPD programmes under review. Based on a synthesis of the specializations and orientations, the objectives and subjects and courses offered by the programmes, these conclusions can be used in WP8 by comparing with the corresponding demand for competences from the industry.

As the reviewed courses were chosen based on a spread of the subjects related to the three focal professional groups and a spread towards the type of programme, single courses were reviewed per focal group. Therefore, the review of the programmes did not give the opportunity to give an analysis of differences and similarities in between courses being part of the same focal group or type of programme. Nevertheless, high-level conclusions on the orientation and areas of competences that are built by the existing and reviewed programmes are given. The latter is based on their orientation and course offerings and will be the main input to WP8.

Full programmes, or programmes existing out multiple subjects/courses, are focused on the "T-shaped professional", a metaphor used in job recruitment to describe the abilities of persons in the workforce[9]. The vertical bar on "T" represents the depth of related skills and expertise in a single field, whereas the horizontal bar is the ability to collaborate across disciplines with experts in other areas and to apply knowledge in areas of expertise other than one's own. Single courses, on the other hand, are characterized by its dedicated and specific subjects defined goals.

From Appendix 8.4, it can be seen clearly that relatively more organizations are delivering programmes of the type facilitating and management, whereas less pure aerospace engineering LLL/CPD programmes are found. The aircraft technology courses are, probably

[9] "The hunt is on for the Renaissance Man of computing," in The Independent, September 17, 1991.

due to their inherent topic interest, to a less extent available and are always short of nature (1 week or shorter). The courses account for 13% of the total courses, whereas the facilitating and management courses are widely available.

The technology driven (e.g. Cranfield) programmes show competences very much related to the understanding of the technology behavior, they project engineering competencies. Programmes following up a national degree or certified diploma show vocational competences either from an academic or certified job point of view. The programmes with facilitation topics (excl. maintenance and ATC) on the other hand have competences focused on process and operational governance in which there is an inherent trend where hard skills are added with soft skills.

5 Surveys

5.1 Rationale

The surveys provided the main tool for the collection of data that are primarily relevant to the gap assessment process. The adaptation of the Four Gaps Framework (presented in Figure 3) to the scope of the EDUCAIR project led to the identification of *relevant groups of stakeholders* targeted by the survey as the key sources of information for assessing the various competence gaps. Table 15 provides an overview of the targeted stakeholders (institutional actors listed in the upper part) along with the "profiles" of individual respondents (lower part). Four major types of relevant stakeholders were identified:

1. Companies
2. Employees
3. Universities
4. Graduating students and graduates

Table 15: Overview of Targeted Stakeholder Groups by the Survey

INDUSTRY (demand side)	EDUCATION (supply side)
• Airlines • Airports • Companies involved in air traffic management (such as air traffic control organisations) • Aircraft manufacturers and suppliers	• Universities with engineering programmes involving air transport / aeronautics (1st and 2nd Bologna cycles) • Universities with research and Ph.D. programmes in air transport / aeronautics (3rd Bologna cycle) • Professional training institutes
Relevant Stakeholders: 1. Managers of new employees and people recruiting new employees (human resources) 2. New employees (max. 5 years' experience) 3. The employees/professionals (with more than 5 years' experience	Relevant Stakeholders: 1. Heads of departments, programme directors / coordinators or academic staff / faculty members involved in targeted programmes 2. Graduating students 3. Graduated students (pursuing a doctorate) 4. Graduates that are not currently working in the air transport / aeronautics sector 5. Doctoral candidates / Researchers (post-doctoral fellows)

Source: (EDUCAIR, 2012)

A tailored survey was designed and launched for each stakeholder group, in a total of five online surveys running in parallel for almost 2 months (end of October – end of December 2012[10]). These are presented below:

1. **SURVEY 1** targeted Professionals involved in the management and/or recruitment of new employees in the Air Transport or Aeronautics sector. The survey was available online at: https://www.surveymonkey.com/s/industrysurveycompanies

2. **SURVEY 2** targeted graduated Employees working in the Air Transport or Aeronautics sector with an educational background in any of the following areas:
   - ☑ **Engineering Degree** - all levels of Bologna, i.e., Bachelor (e.g., BEng, BSc), Master (e.g., MSc, MEng) or Doctoral (e.g., PhD, EngD),
   - ☑ **Management, Business, Economics, Law, Public Policy** – ONLY 3rd Level of Bologna, i.e., Doctoral (PhD, DBA, DSc, ScD, LLD, DCL, etc.).

   The survey was available online at: https://pt.surveymonkey.com/s/surveyemployees

3. **SURVEY 3** targeted Faculty Members (with emphasis on programme directors and/or heads of departments) of Universities / Educational Institutes offering educational programmes (engineering for the 1st and 2nd cycle), research or PhD studies in Air Transport or Aeronautics.
   The survey was available online at:
   https://pt.surveymonkey.com/s/educationsurveyuniversities

4. **SURVEY 4** targeted Researchers and Students (Bachelor, Master and Doctoral) of Universities or Institutes offering educational programmes in Air Transport or Aeronautics. The survey was available online at:
   https://pt.surveymonkey.com/s/surveyphdstudents

5. **SURVEY 5** targeted Graduates from Universities in Engineering programs or PhD programmes in Air Transport or Aeronautics who are not currently working in the Air Transport or Aeronautics sector. The survey was available online at:
   https://pt.surveymonkey.com/s/surveygraduates

Considering that different Work Packages (WP4, WP5, WP6) provide input to the assessment of different gaps (WP8) (please refer to Figure 5), it becomes clear that the design of the

[10] Following the Consortium Meeting held on February 27, 2013 in Brussels, a second "wave" of survey dissemination was decided and the survey was extended to close on March 15.

surveys entailed a strong articulation and coordination among WPs. In particular, WP4 was mainly involved in Survey 3. As already mentioned, the results of the Students' survey (Survey 4) and their respective analysis / discussion will take place in the subsequent deliverable (WP5/D5.9 Deliverable) that covers the entire "Researchers and Students" survey (Survey 4).

This section presents the results of the Universities' Survey (Survey 3). It involves an online survey of academic staff / faculty members and programme directors / coordinators or heads of departments from academic educational programmes of all 3 Bologna Cycles with emphasis on the 1st and 2nd cycle engineering programmes in AAT identified in the review and listed in Section 4.2.1. Its main objective is to get feedback and the viewpoints from the "education providers" side in terms of the competences[11] that the educational institutions (aim to) provide to their students as input to the gap assessment exercise in WP8. A structured survey instrument was developed for the purposes of the online survey of Universities (Appendix 8.3).

The survey instrument contained both open and closed-ended questions and was structured into three main parts. The first part contained general information about the background of the respondent. The second part was divided into several sub-sections containing mainly questions about numbers of graduating students, the perceived importance of qualifications and skills for recruitment in the sector, an assessment of the current educational offer, the competences currently taught by the surveyed programme, and the perceived benefits of cooperation with industry. The last part of the survey was open for comments or remarks from the respondent.

5.2 Dissemination Efforts and Description of the Collected Surveys

The online survey remained open for a period of almost 2 months (end of October – end of December 2012). Following the EDUCAIR Consortium Meeting held on February 27, 2013 in Brussels, a second "wave" of survey dissemination was decided took place until March 15. For the dissemination of the surveys, mass mailing lists were initially activated. In order to increase the survey response rates without compromising quality/relevance of survey responses, dissemination efforts were further intensified by means of a more targeted approach. This involved personal, targeted messages – and in some cases (e.g., Heads of

[11] For a more detailed discussion on the definition of competences in the EDUCAIR context, the reader is referred to EDUCAIR D3.7 Deliverable (EDUCAIR, 2012).

Departments or Program Directors/Coordinators) even short telephone interviews – based on the list of relevant programmes identified in the review process (Section 4.2.1).

Following an intensive dissemination effort with weekly updates/follow-up, the Universities' survey has received 80 fully completed and applicable online questionnaires from 51 different Universities / Educational Institutes at 18 countries (16 of which in EU 27) (

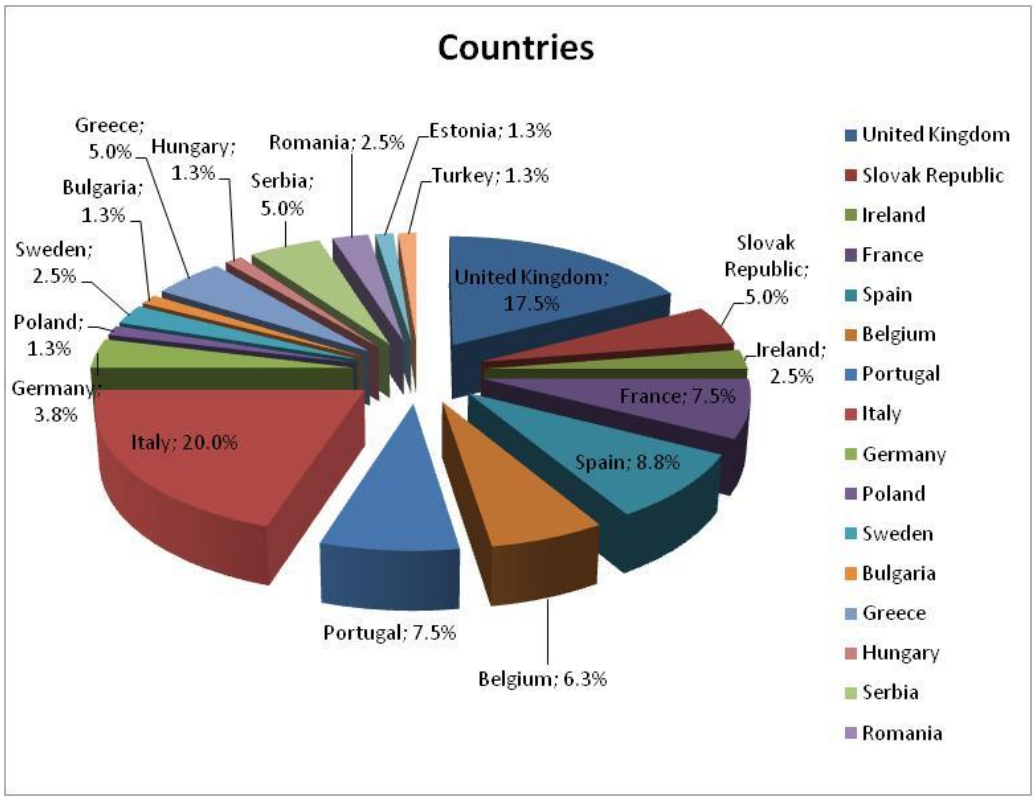


Figure 18). The detailed list of Universities / Institutes participating in the survey (Survey 3) is provided in Appendix 8.5.

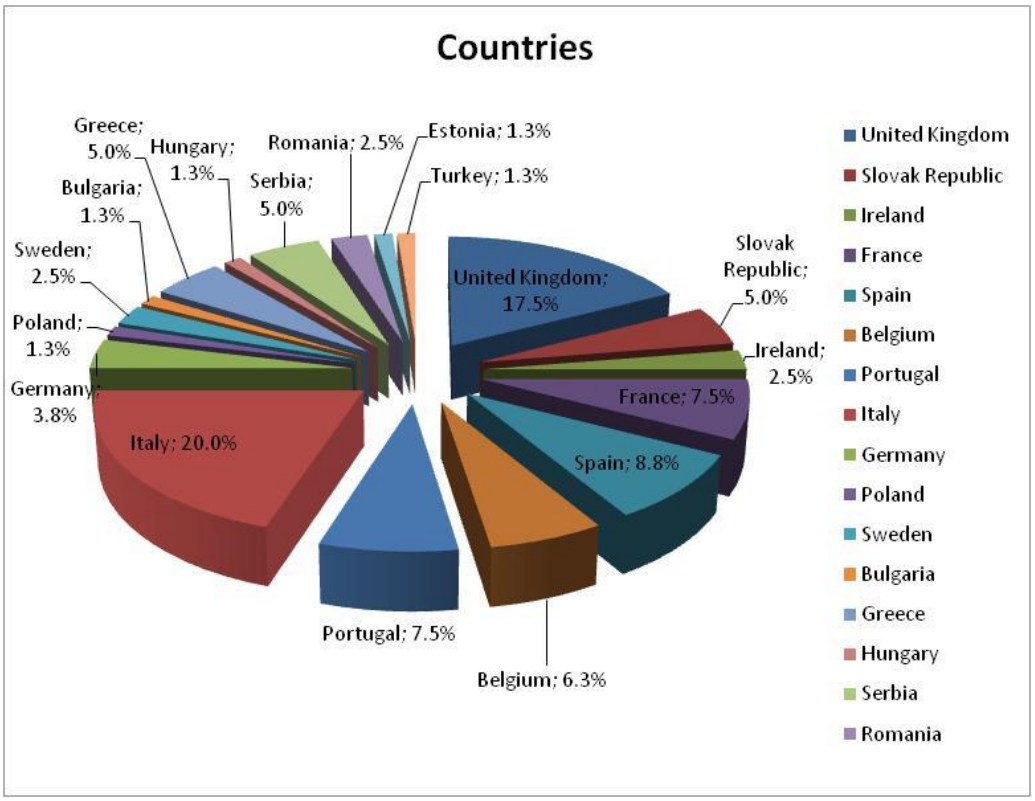


Figure 18 – Percentage (%) of Countries' Representation in the Survey

In their large majority, the respondents are faculty members (almost 60%) or research associates (10%), while a satisfactory percentage (over 30%) of senior faculty including heads of departments and programme directors (in certain cases the dean/vice-dean for academic affairs) has also participated in the survey (

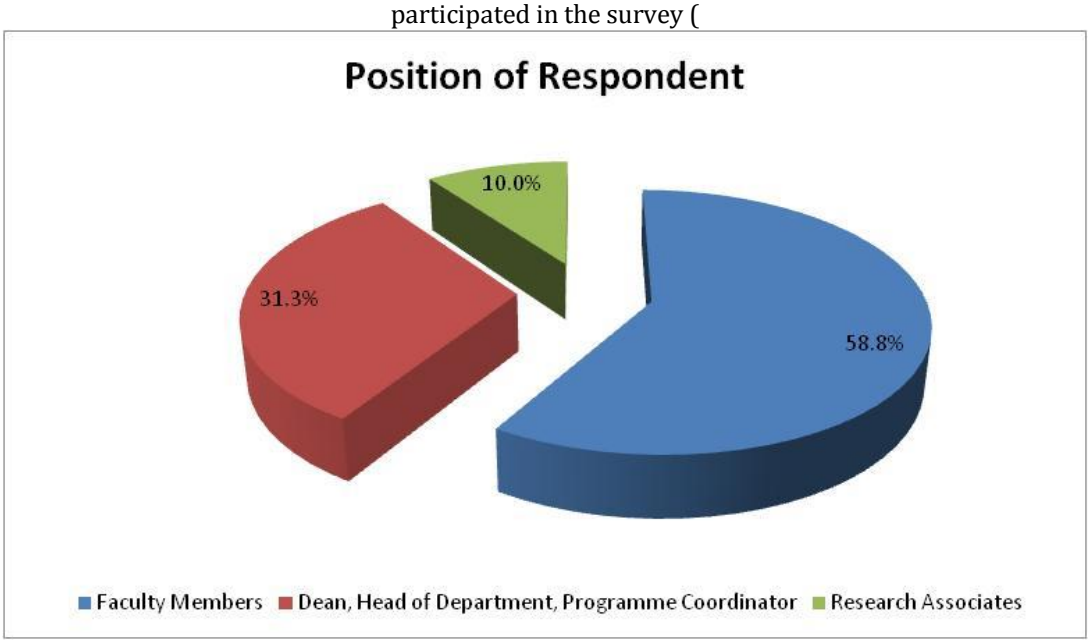


Figure 19).

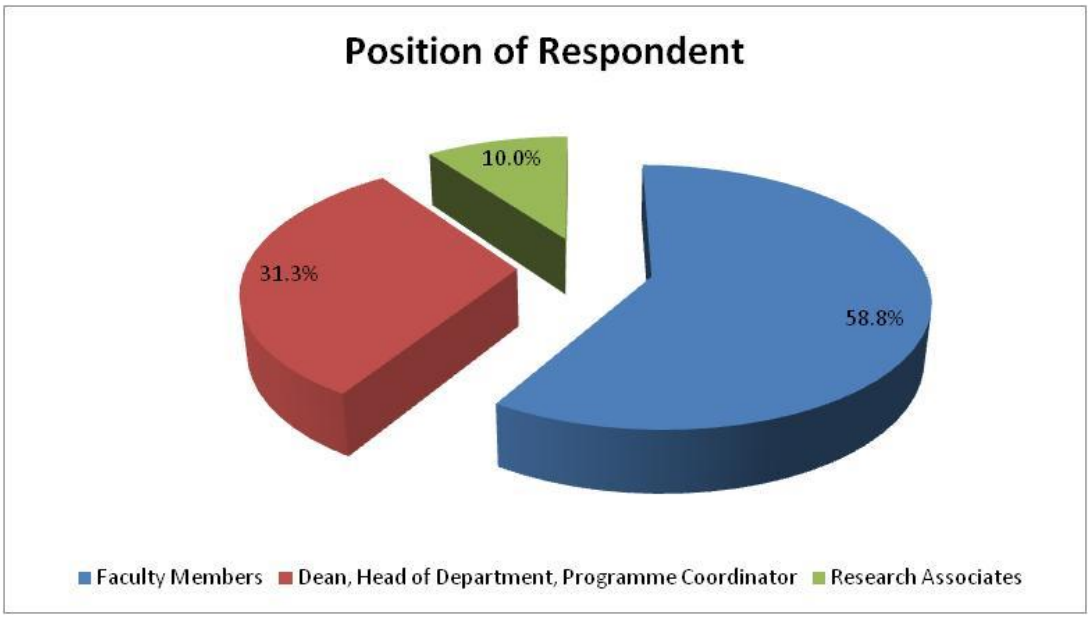


Figure 19 –Position of Respondent

The respondents come mainly (41%) from aeronautical/aerospace engineering departments or other engineering departments (e.g., mechanical, civil, electrical, industrial) (26%), with a large percentage (almost 33%) involved in non-engineering departments (e.g., air transport management, air transport, applied sciences) (

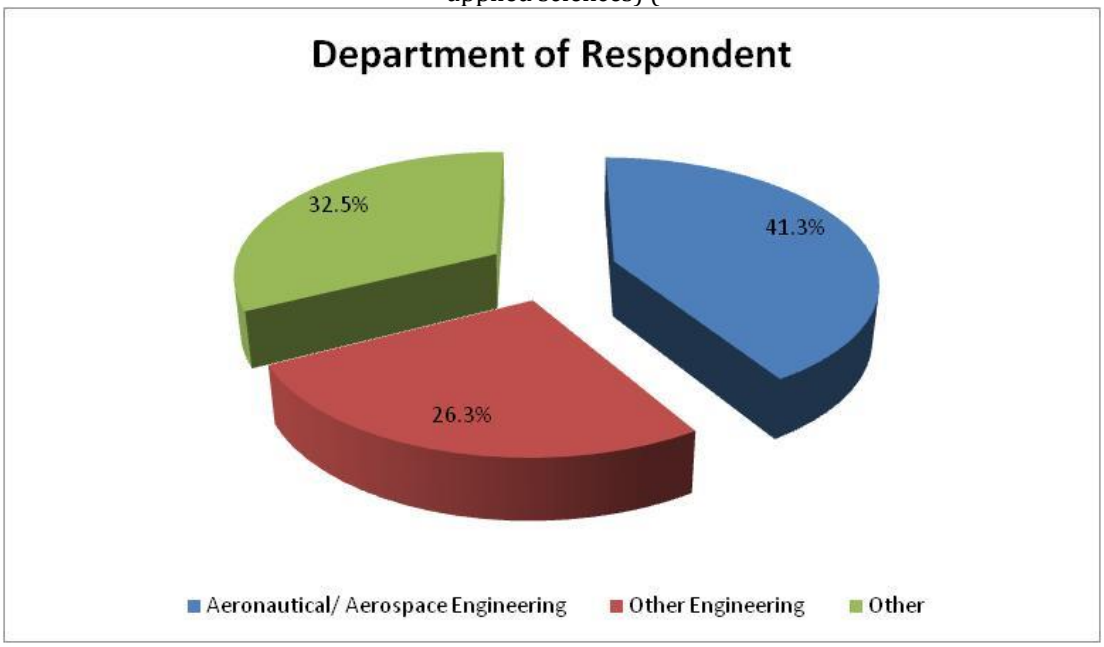


Figure 20). The last two categories of respondents (i.e., other engineering, non-engineering) have retained for analysis for two reasons. First, they have some involvement in the offering of AAT-related programmes / degrees especially for the 3rd cycle. Second, due to the inherent interdisciplinary substance of AAT studies, certain categories of competences may not be directly developed by typical aeronautical / aerospace engineering programmes or departments, but they may be complemented by other engineering (e.g., civil engineering) or even non-engineering disciplines (e.g., air transport / airport management). At the outset, it

was decided to include and process in this survey responses from a large spectrum of programmes / departments that are somehow involved in the offering of relevant competences to students.

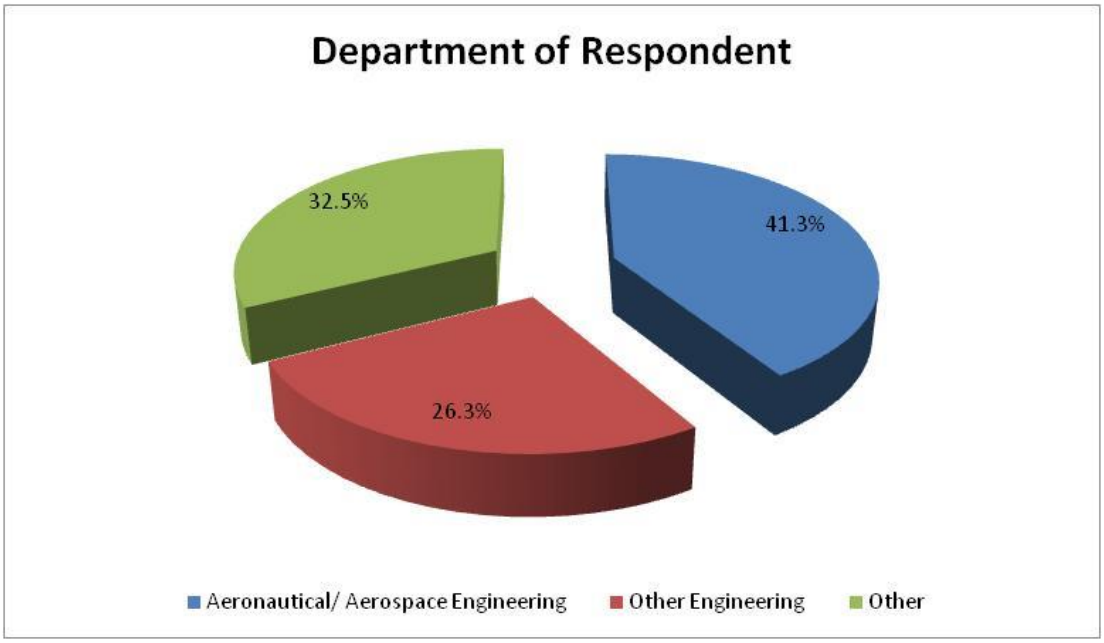


Figure 20 –Department of Respondent

5.3 Key Findings of the Survey of University Programmes

The respondents were initially asked to indicate their perceptions about the relevance of various types of degree programmes at all 3 cycles (including vocational programmes) for

getting recruited in the AAT sector. Regarding the 1st and 2nd cycle engineering programmes (

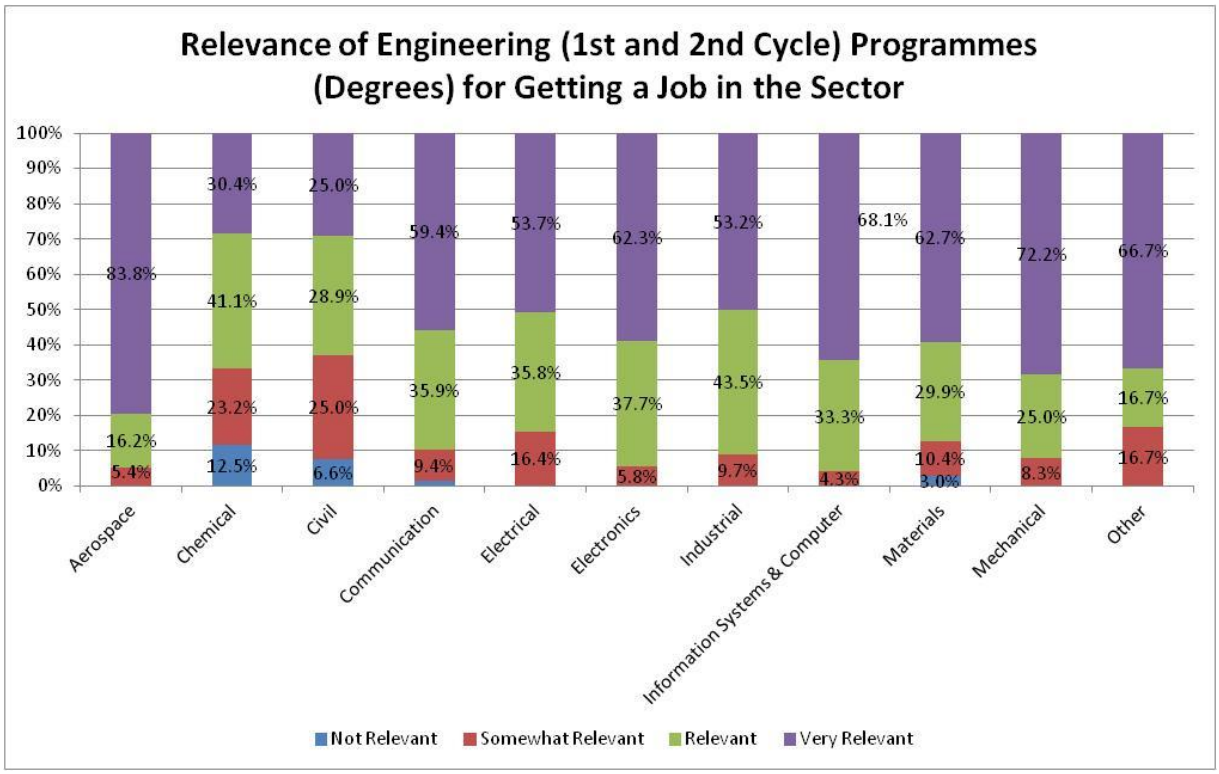


Figure 21), aerospace engineering was naturally considered the most relevant educational background and received the top ranking (average 3.95). It is also interesting to see that engineering disciplines like mechanical, electronics, as well as information systems and computer engineering are very highly ranked (average 3.74-3.81). This might be attributed to the fact that these engineering disciplines have a crucial, and in most cases, rather complementary role to aerospace engineering. On the other hand, civil engineering has received the lowest ranking despite its major contribution in the offering of competences related to infrastructure design and construction. Other suggested educational backgrounds or topics that were considered relevant were environmental engineering, traffic engineering, energy, nanotechnology, as well as applied and computational mathematics.

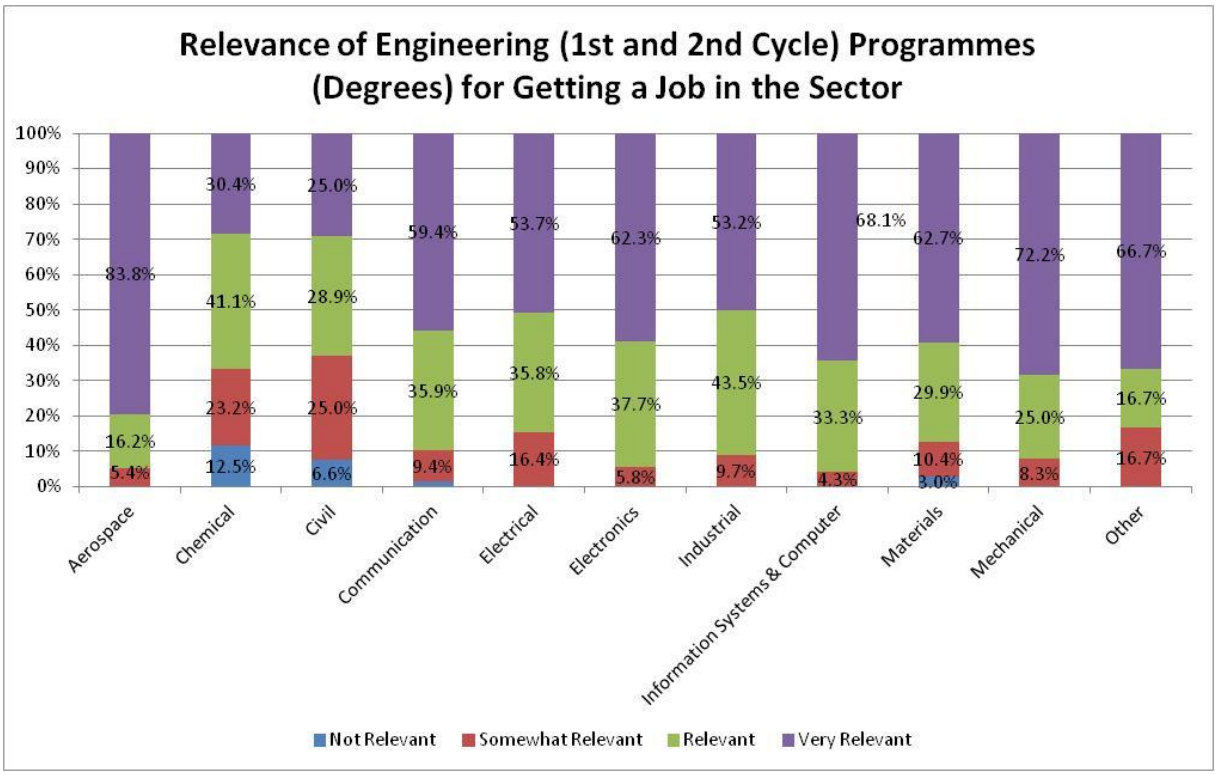


Figure 21 – Relevance of Engineering (1st and 2nd Cycle) Programmes (Degrees) for Getting a Job in the Sector

For the 3rd cycle programmes / degrees (

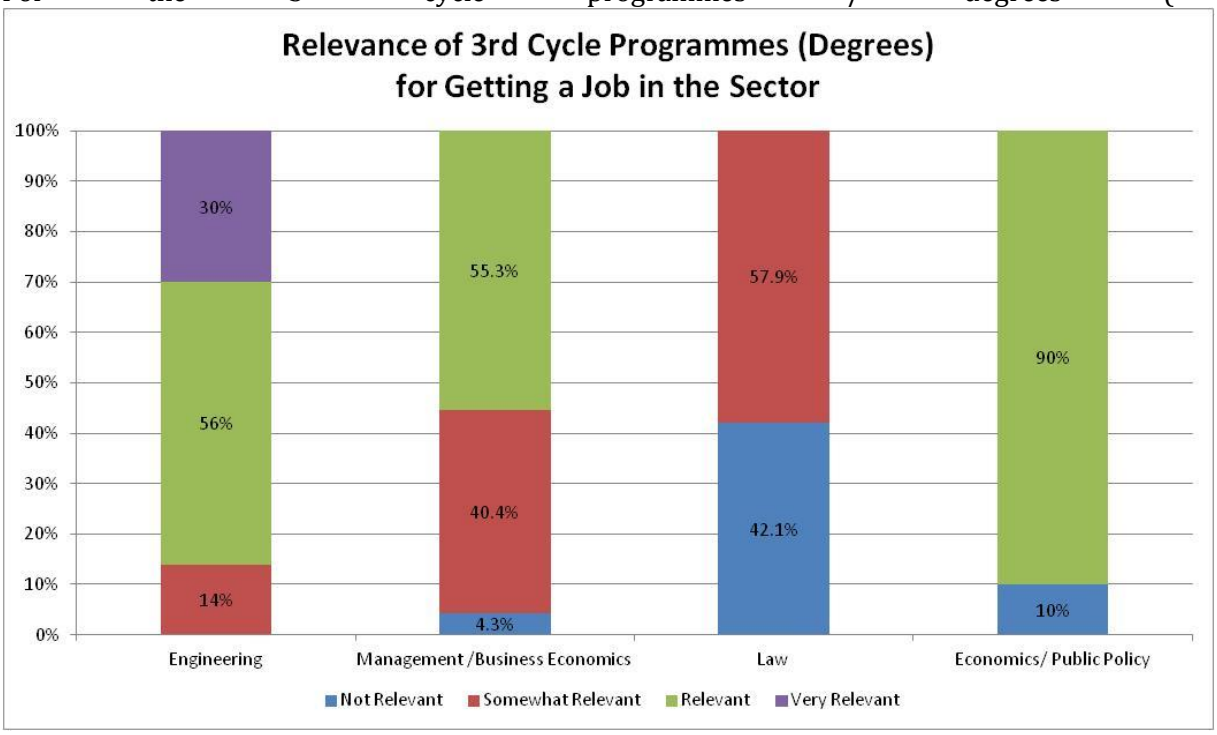


Figure 22), engineering studies was admittedly considered the most desired educational background (average 3.16), while economics have also received a high score (average 2.80). A more general management/business background was found less important (average 2.51)

and the same applies to law studies that received the lowest score (average 1.58). Lower scores can be probably justified by the fact that general management studies and especially law studies are considered to be more applicable or of direct use to a subset of engineers pursuing top management or highly specialized career paths in the sector.

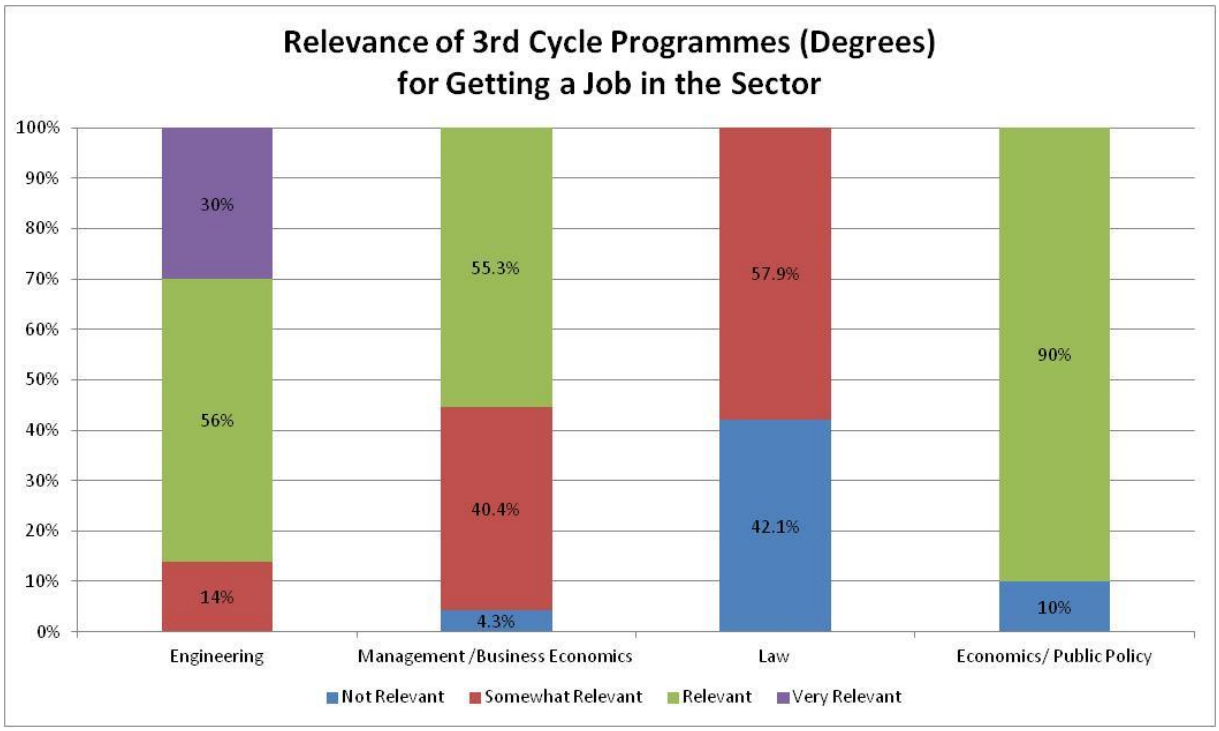


Figure 22 – Relevance of 3rd Cycle Programmes (Degrees) for Getting a Job in the Sector

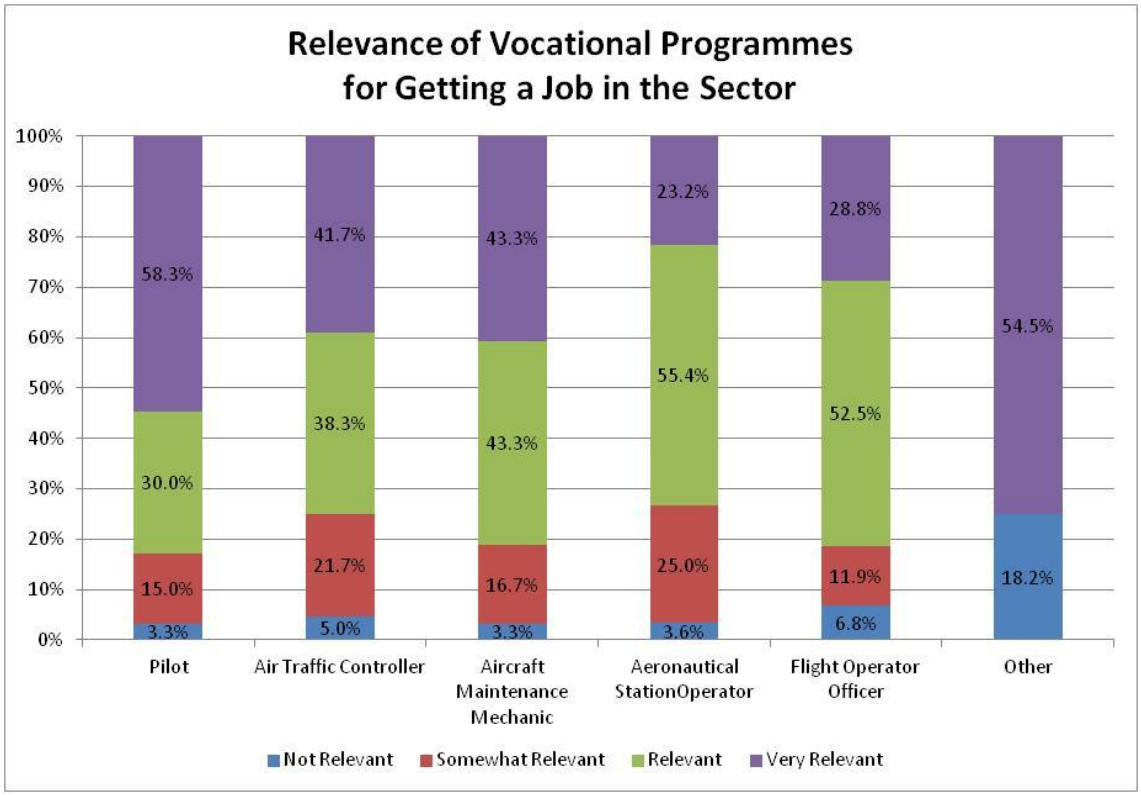


Figure 23 presents the respondents' perceptions on the relevance of vocational programmes that are typically leading to a professional license. Most of the identified vocational programmes were considered relevant for getting a job in the AAT sector, with pilot and aircraft maintenance programmes obtaining the highest ranking (average 3.57 and 3.40, respectively). Other suggested programmes of this category that were considered relevant are aircraft designer, stress engineer, production and operation engineer, as well as aviation manager.

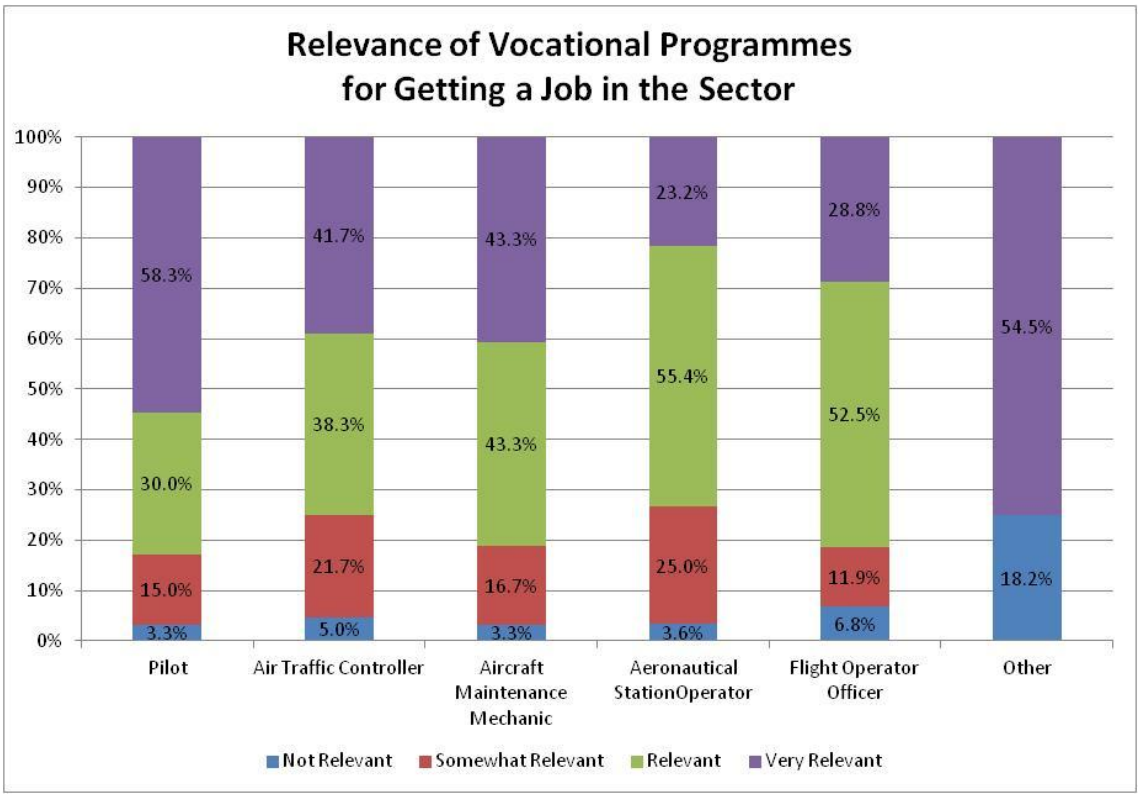


Figure 23 – Relevance of Vocational Programmes for Getting a Job in the Sector

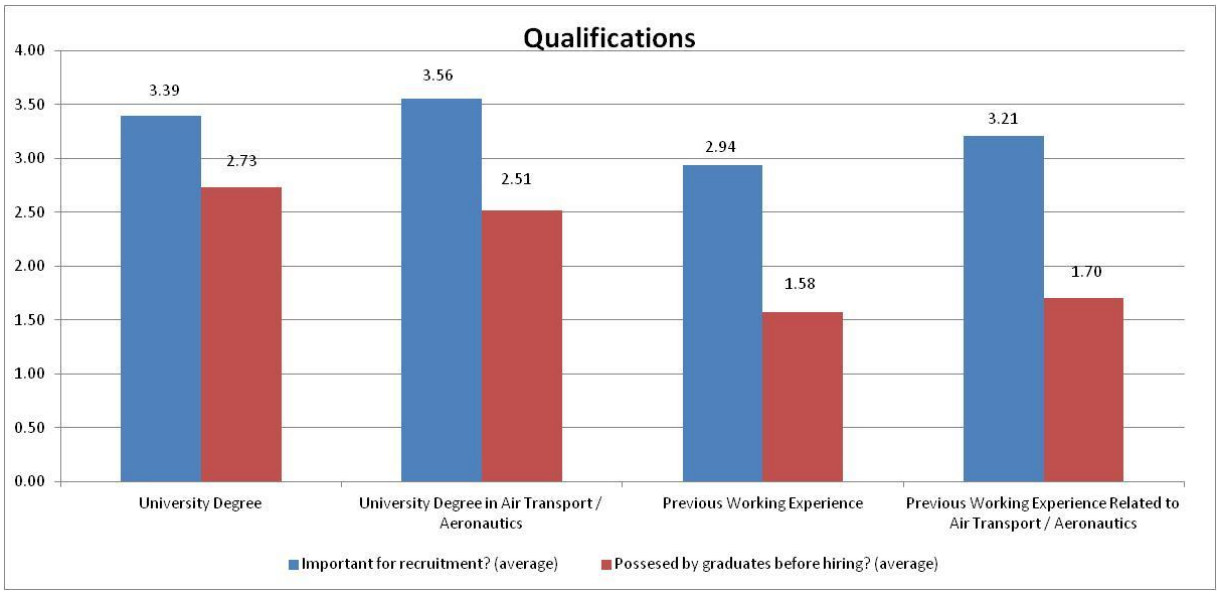


Figure 24 and

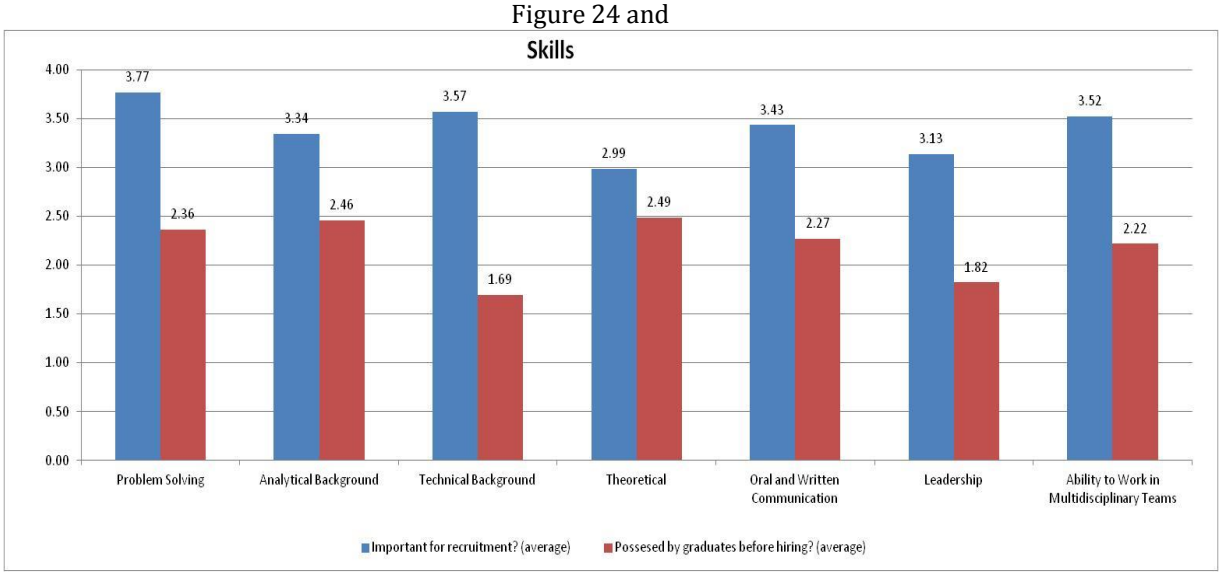


Figure 25 report the desired qualifications and personal skills of graduates as an educational asset for getting recruited in the AAT sector. Blue bars provide a measure of the perceived importance of a certain qualification/skill for getting a job in the sector. Average importance ratings are used on a scale of importance from 1-4 (1: Not important, 2: Somewhat Important, 3: Important, 4: Very important). On the other hand, red bars indicate the extent to which a certain qualification/skill is possessed by graduates before hiring. Again, average values are used on a 4-point scale (1: Up to 25%, 2: 25%-50%, 33: 50%-75%, 4: More than 75%). A University degree, preferably in relevant AAT topics, has obviously received the highest importance rating. Previous working experience was also considered important, but there was some clear preference towards an AAT-related working experience. An interesting observation that can be made by contrasting the two bars is that graduates are considered to fall substantially short in working experience with emphasis on relevant working experience in the sector that is highly regarded in terms of importance. This is a bit of a paradoxical

situation, where graduates are "penalized" for not having prior working experience. Some possible improvements could be achieved by promoting industry internships or other cooperation activities with industry (e.g., final year project, practical training, research project or thesis while working in the industry) so that students can acquire some relevant working experience even before graduating.

Figure 24 – Required Qualifications for Getting a Job in the Sector

As far as skills are concerned, problem solving, technical background, team working as well as oral and written communication are considered the most important skills of graduates for entering the workforce. Other suggested skills considered also important are software programming and human factor and interpersonal relationship skills. In general, there seems to be a tendency that graduates do not possess at high levels many of the desired skills for getting a job in the sector. The latter constitutes a gap that needs to be considered in the alignment and adjustment of existing educational programmes.

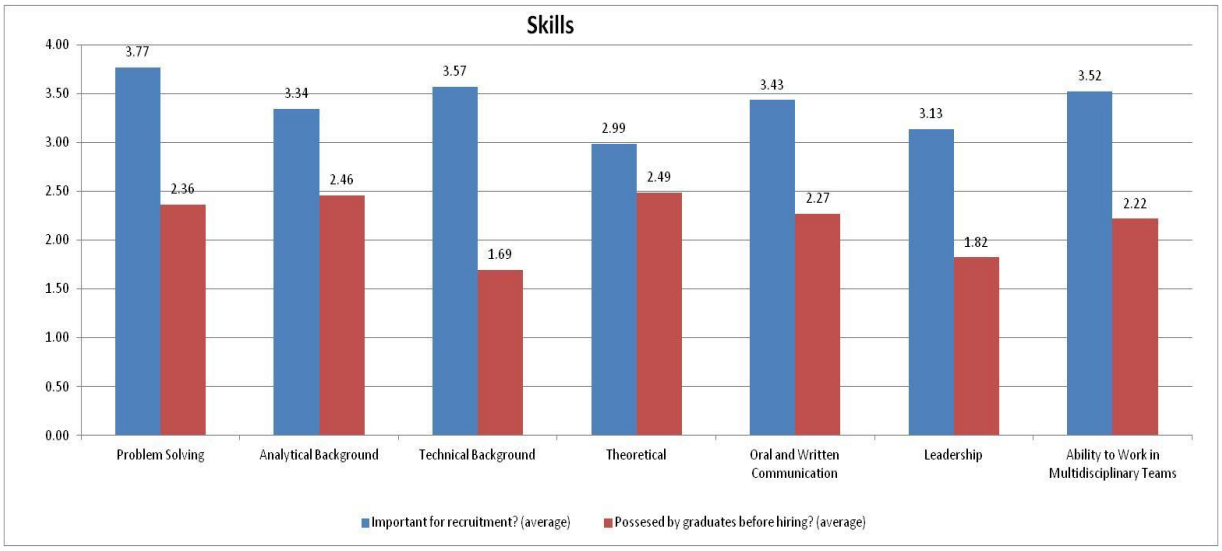


Figure 25 – Required Skills for Getting a Job in the Sector

Respondents were also asked to assess the quantity of existing educational programmes. Based on

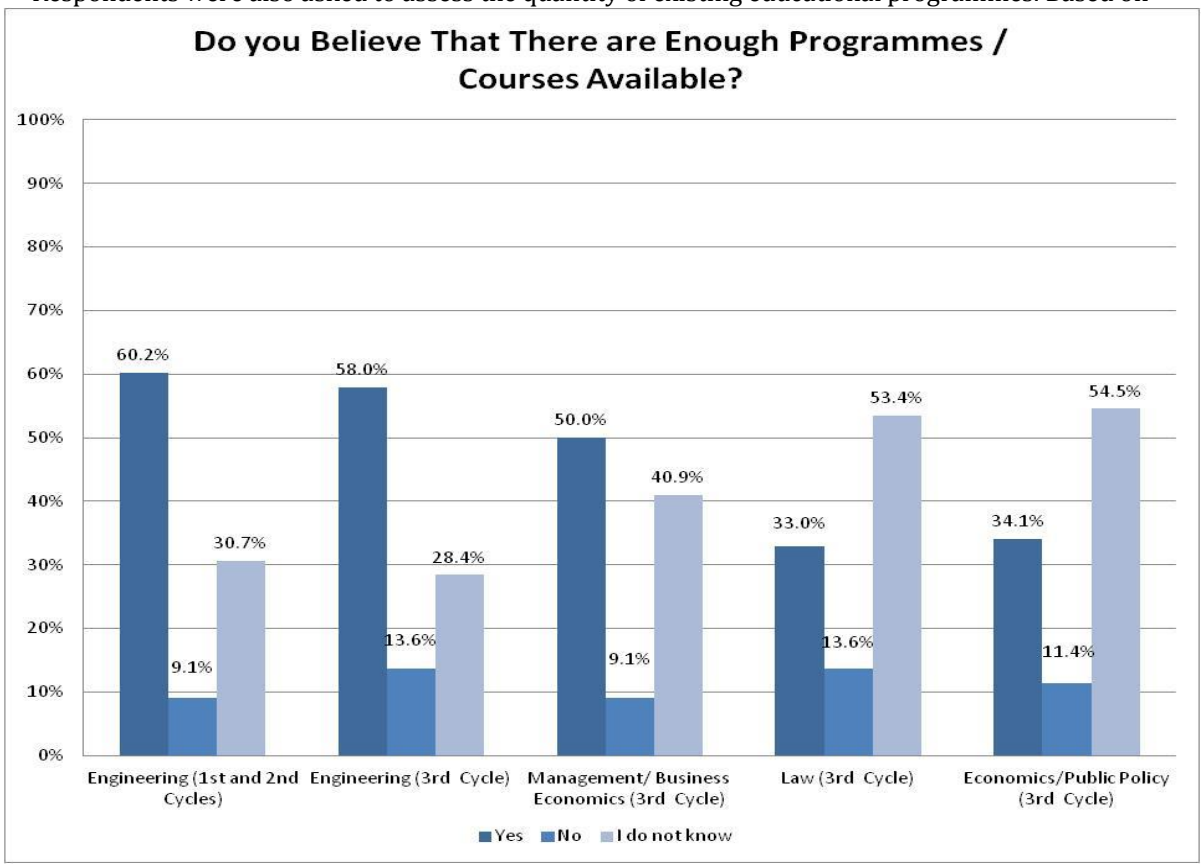


Figure 26, it can be concluded that there are enough engineering programmes at all 3 cycles and general management / business economics programmes at the 3rd cycle. Fewer programmes are available on law and economics/public policy studies at the 3rd cycle. Nevertheless, judgments related to non-engineering programmes of the 3rd cycle should be treated with much caution since a large number of respondents mainly coming from engineering disciplines/departments was not familiar with this question (large percentages

of "I do not know" bar). Furthermore, the respondents also provided their suggestions for other programmes or courses that can be developed such as aerospace system dynamics, safety enhancing liability processes, process reengineering, foresight environment policy, system design and innovation, as well as aviation law and deregulation. As far as engineering programmes are concerned, it is clear that the majority of respondents considered that existing programmes are sufficient, therefore, future improvement efforts may be focused on the update / restructuring of educational curricula of existing programmes so that they can better match with industry needs in terms of competence requirements.

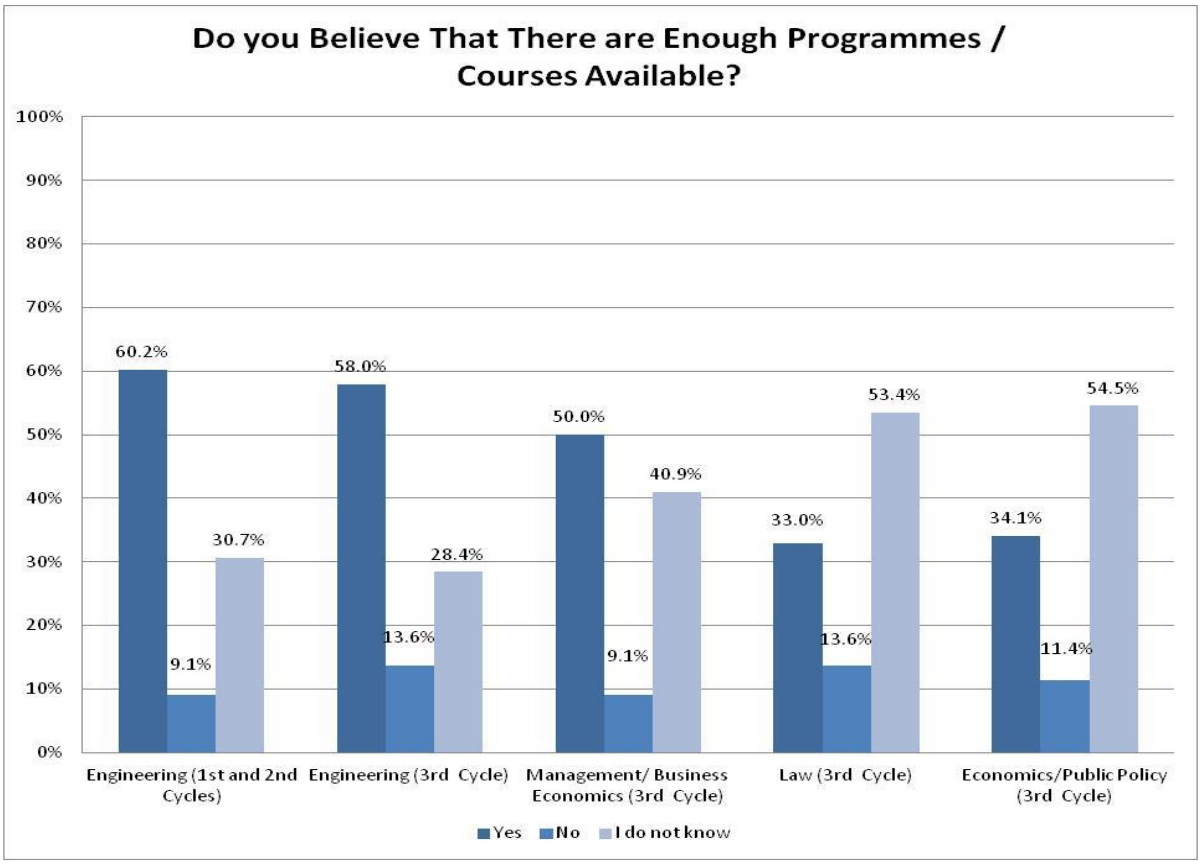


Figure 26 – Quantity of Existing Educational Offer

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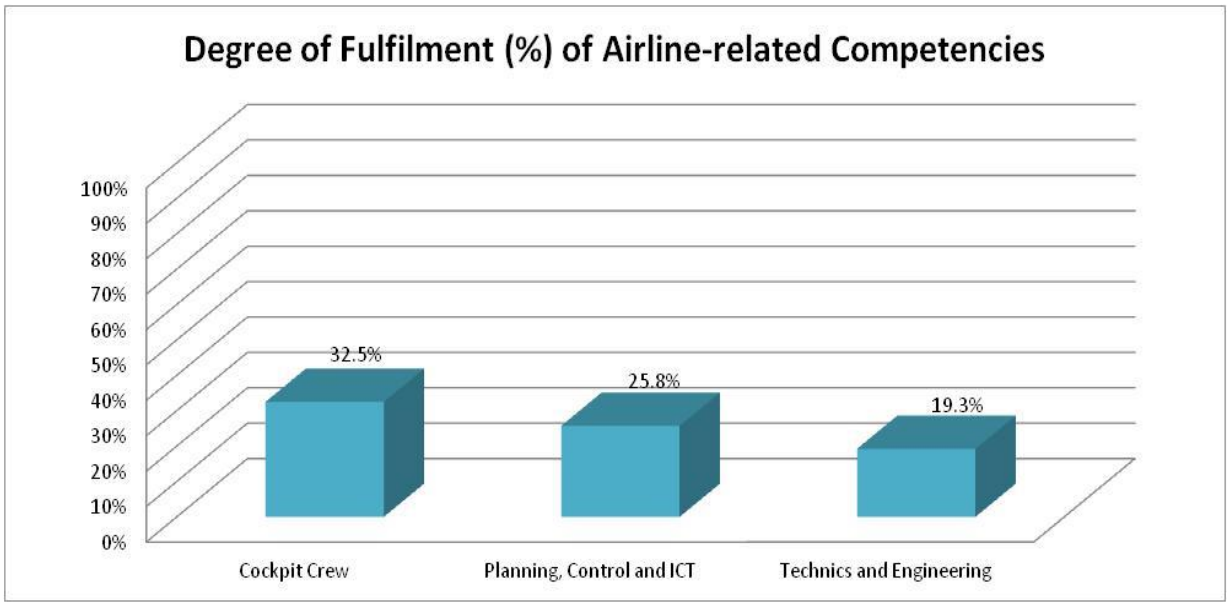


Figure 27,

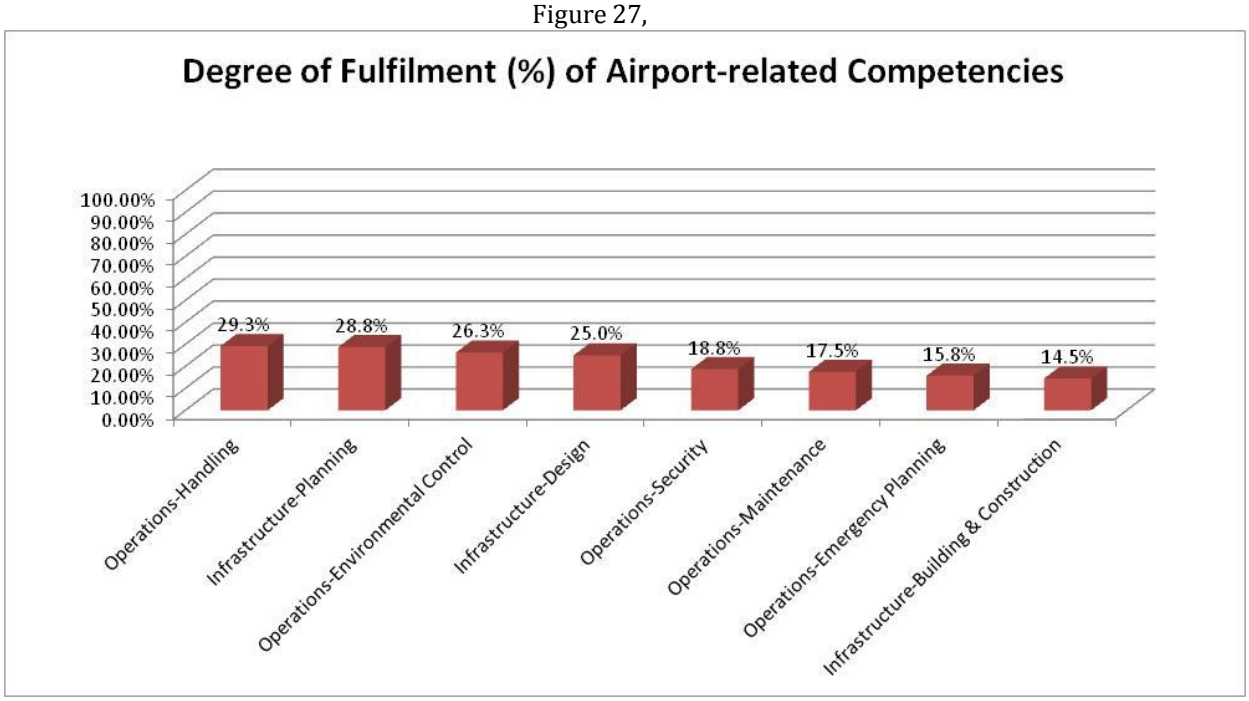


Figure 28,

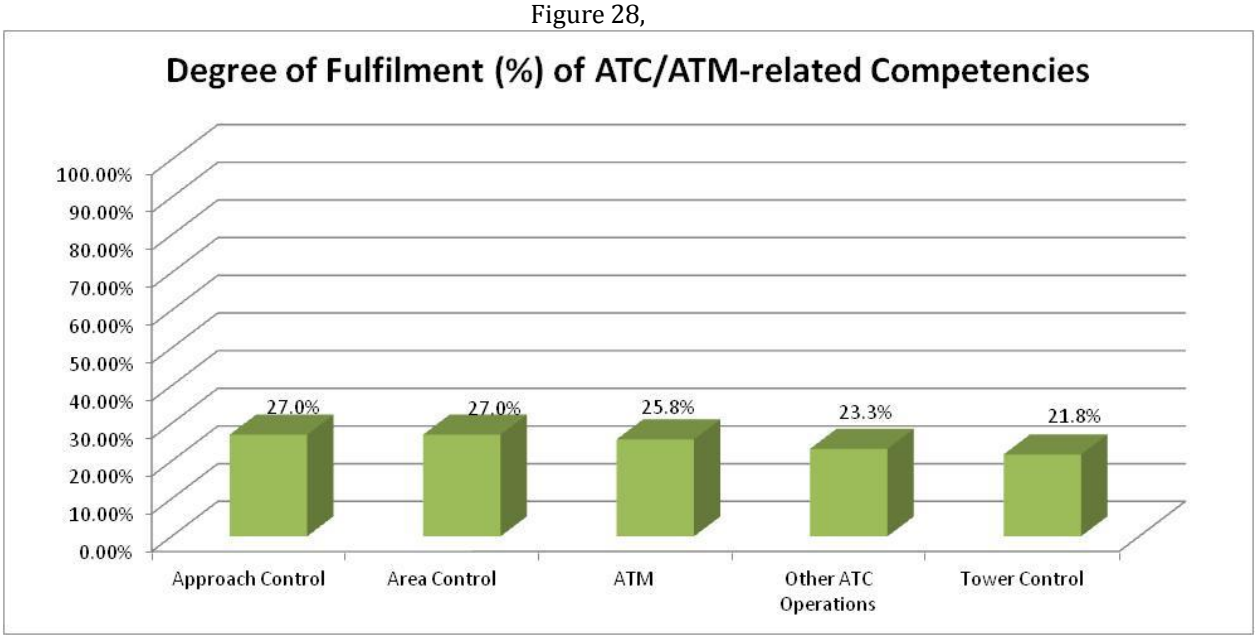


Figure 29,

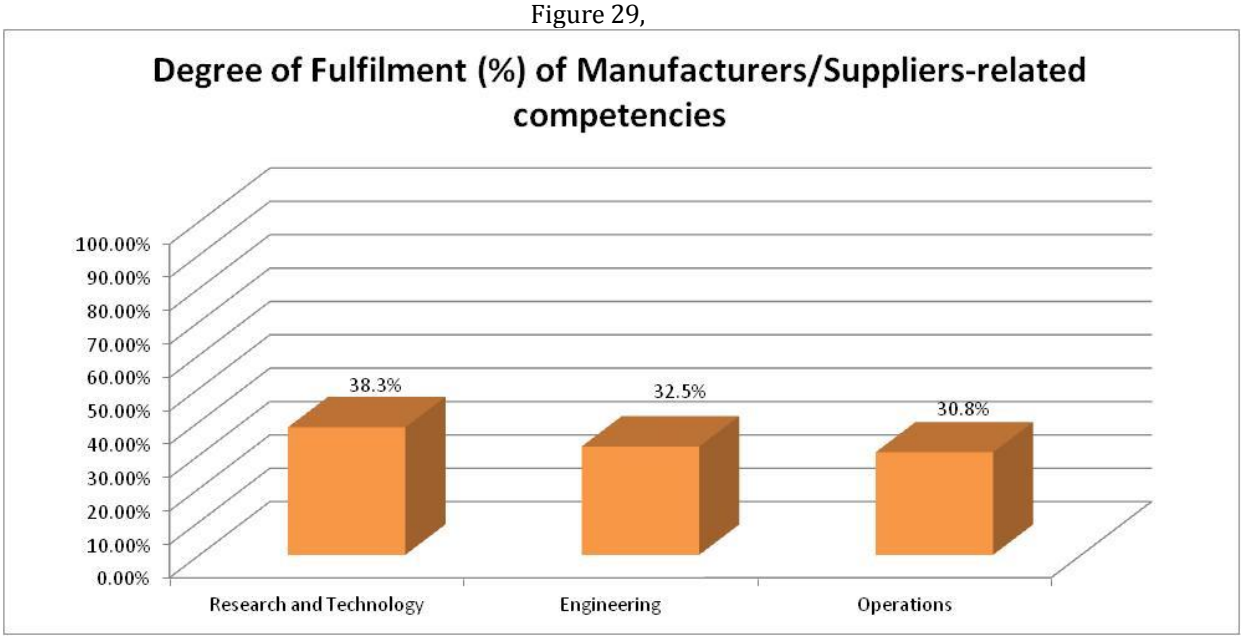


Figure 30) convey the judgments of surveyed faculty members and programme directors / coordinators on the various types of competences that are currently built / taught by the relevant programmes of their educational institutions. They basically measure the percentage of programmes that are currently offering such competences. The ultimate objective of this analysis is to obtain an aggregate picture of the expected portfolio of student competences that the educational institutions (aim to) provide to their students as input to the gap assessment exercise in WP8. The competences were derived from the list of competences defined within WP3/ D3.7 Deliverable (EDUCAIR, 2012) and correspond to the high-level categories of competences for each of the four identified demand-side actors (i.e., airlines,

airports, ATC/ATM authorities and organizations, manufacturers / suppliers in the AAT sector).

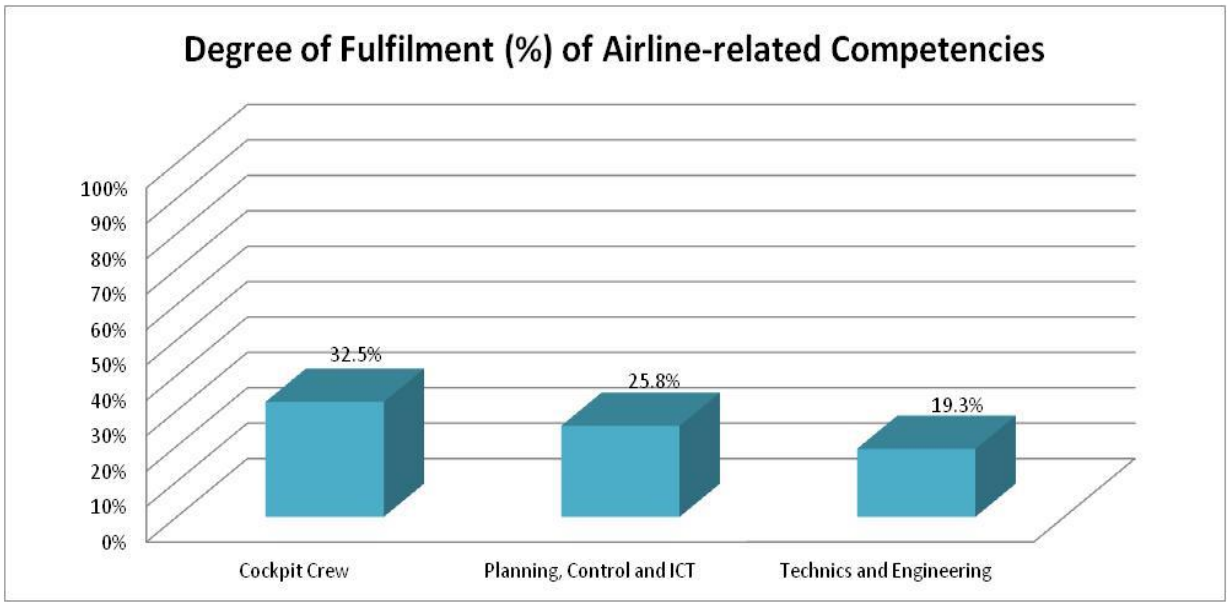


Figure 27 presents the assessments of the airline-related competences. In line with the review of existing educational curricula ("typical profile"), where airline topics / course modules were found to be hardly available, airline-related competences are poorly represented in surveyed programmes as well. Cockpit crew-related competences with emphasis on radio navigation and communication, understanding air law and operational procedures and management of technical aspects are offered by roughly one third of the surveyed programmes. Competences related to planning, control and ICT are taught by roughly 26% of the programmes. The emphasis is on safety management, planning and coordination of airline operations, as well as coordination of maintenance. On the other hand, ramp planning and flight dispatching topics are hardly covered. The least covered high-level competence is the one related to airline technics and engineering (19%). Under this category, maintenance and repairing of airframe topics are covered by one third of the surveyed programmes, but there is very limited coverage (almost 10%) of competences related to maintenance and repairing of auxiliary systems, on board instruments, as well as navigation and radio communication equipment. Other airline-related competences suggested by surveyed faculty members are related to crew scheduling and rostering, as well as airline marketing and management.

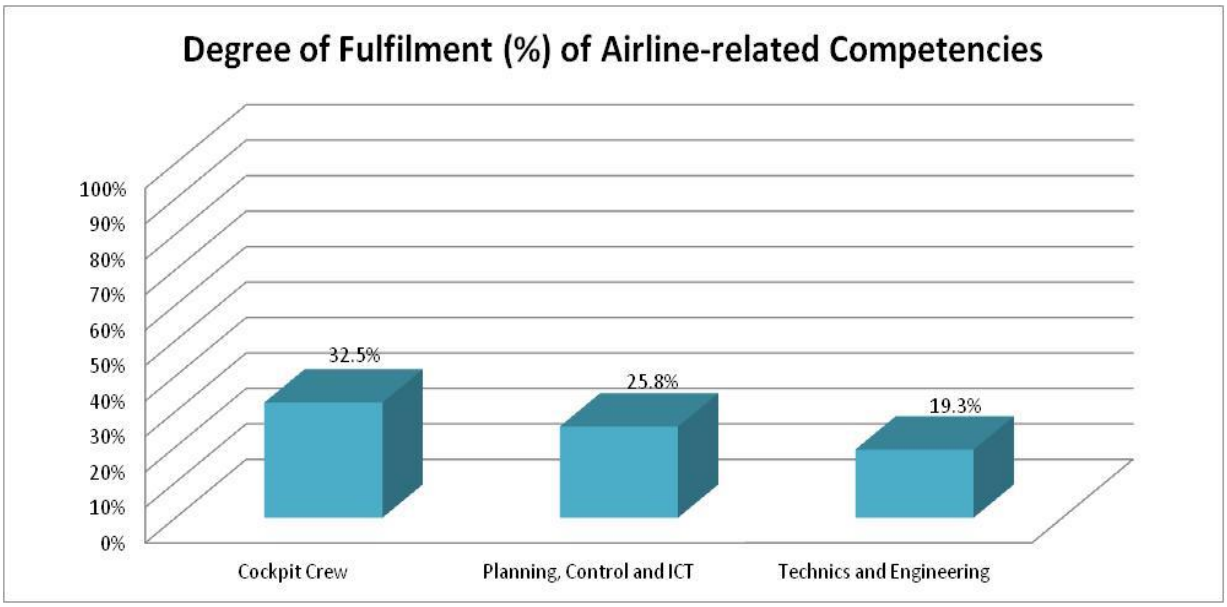


Figure 27 – Degree of Fulfilment (%) of Airline-related Competences

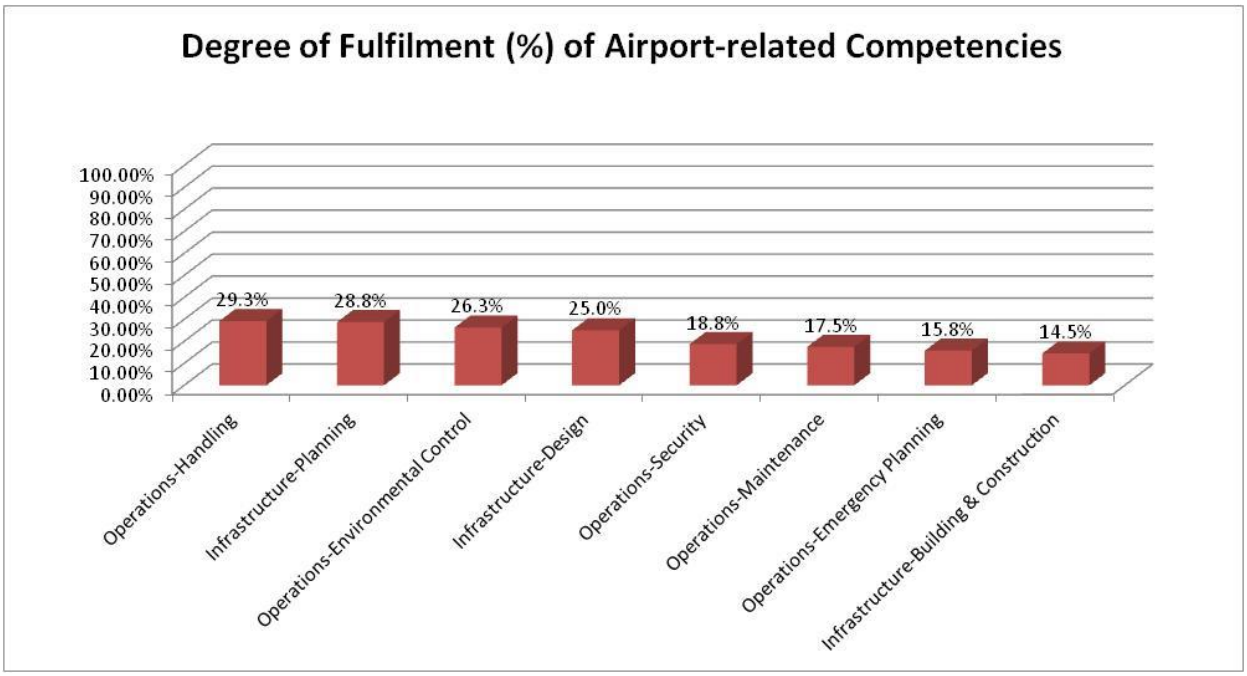


Figure 28 summarizes the assessments of the airport-related competences. The most frequently taught competences pertain to infrastructure planning and design (above 25%) with focus on master planning and the design of airside and terminal infrastructure. Competences related to airport operations with emphasis on environment (mainly noise and emissions control), as well as the handling of passengers and aircraft are also offered by almost one out of four of the surveyed programmes. On the other hand, emergency planning, maintenance and security topics are under-represented in the surveyed programmes. Competences related to infrastructure building and construction exhibit the lowest frequency probably because this is the core subject of civil engineering departments / programmes.

Other topics suggested by respondents include airport marketing and economics, Airport Collaborative Decision Making (CDM), energy and carbon footprint management, airport safety and security, as well as emergency planning (e.g., runway incursion/excursion, incidents/accidents, safety management systems, third party risk assessment around airports) and crisis management.

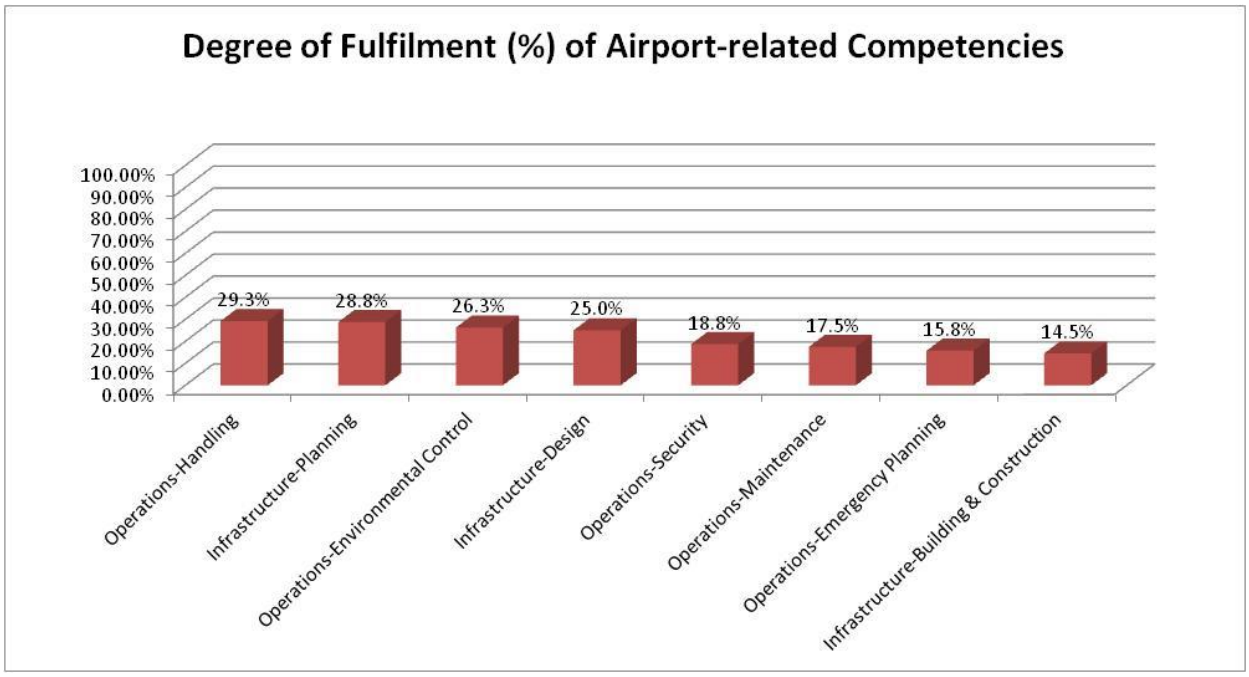


Figure 28 – Degree of Fulfilment (%) of Airport-related Competences

The results of the responses on ATC/ATM-related competences are presented in

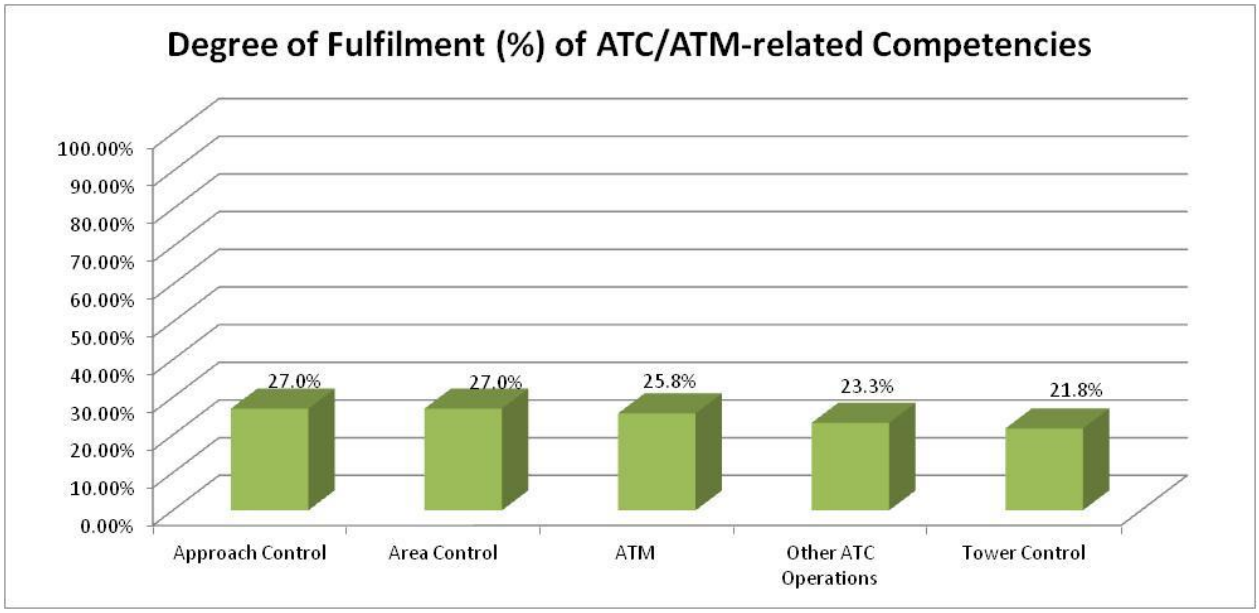


Figure 29. Overall, it can be concluded that most of the high-level ATC/ATM-related competences are somehow covered by roughly one fourth of the surveyed programmes. The

most frequently taught topics relate to the design, development and evaluation of ATC procedures, the management of air traffic capacity and efficiency, and the supervision and planning of approach operations, whereas others that are under-represented are topics typically taught by specialized license programmes for controllers (e.g., approach control, tower and ground movements control, interaction between controllers and the operational environment). Other topics suggested by respondents include the assessment and management of environmental capacity constraints and the full-scale implementation of reduced separation minima.

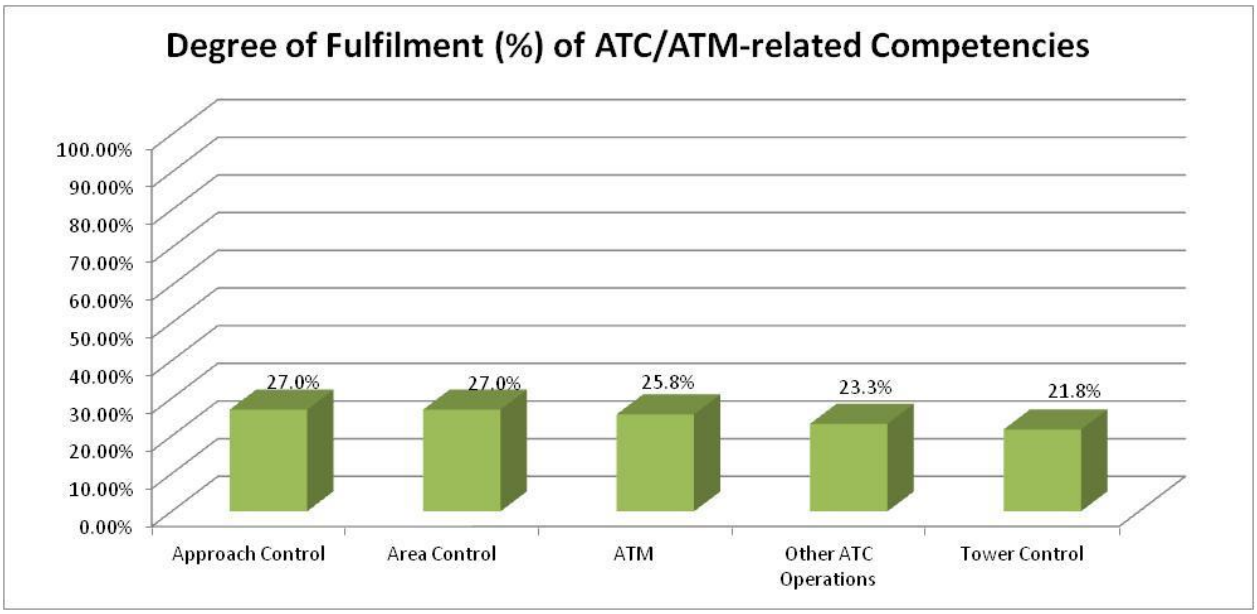


Figure 29 – Degree of Fulfilment (%) of ATC/ATM-related Competences

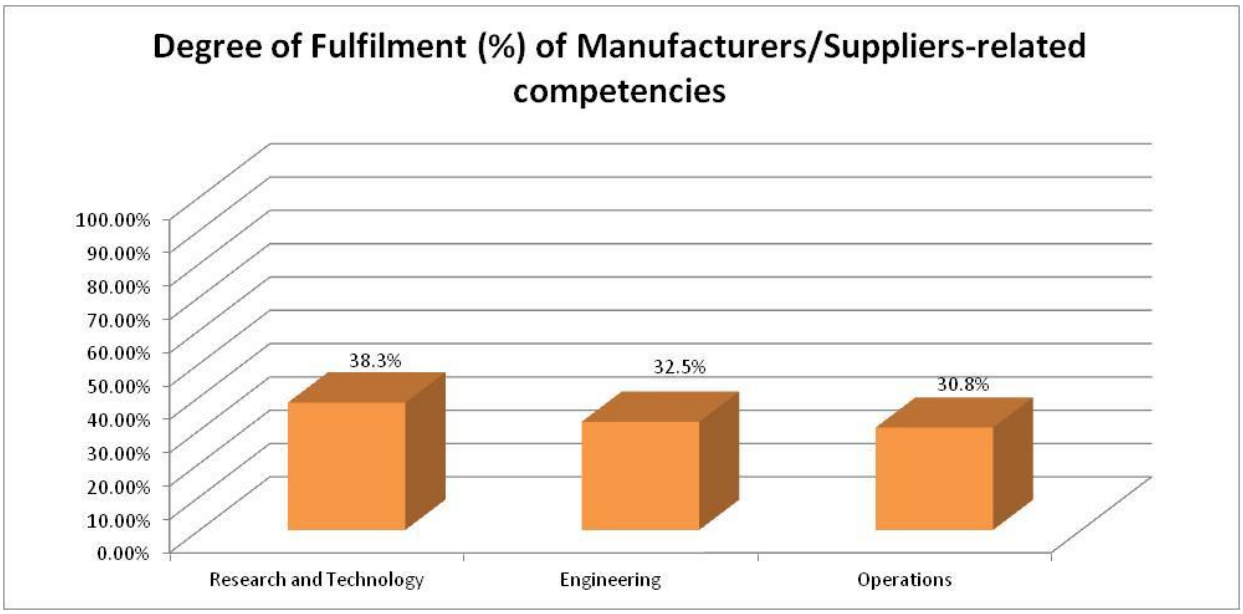


Figure 30 deals with the degree of fulfilment of manufacturers/suppliers-related competences by the surveyed educational programmes. As it can be inferred from

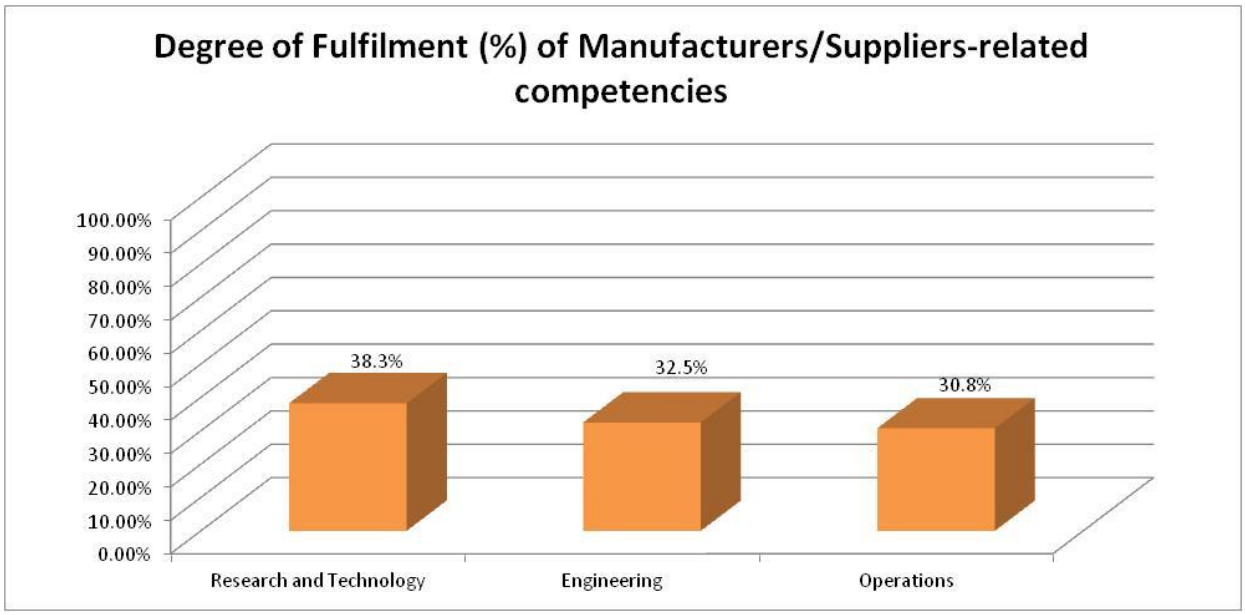


Figure 30, all high-level competences of this category are well balanced and represented in more than 30% of the surveyed programmes. The most frequently taught sub-topics pertain to fluid mechanics and acoustics, propulsion, structural design, manufacturing engineering and maintenance, materials and processes, systems engineering and architecture, airworthiness and certification, flight physics, as well as configuration management. Other indicative topics that are under-represented in the surveyed programmes include customer service, risk management, aircraft operability and design maturity integration, composites design and stress, as well as electrical design / integration.

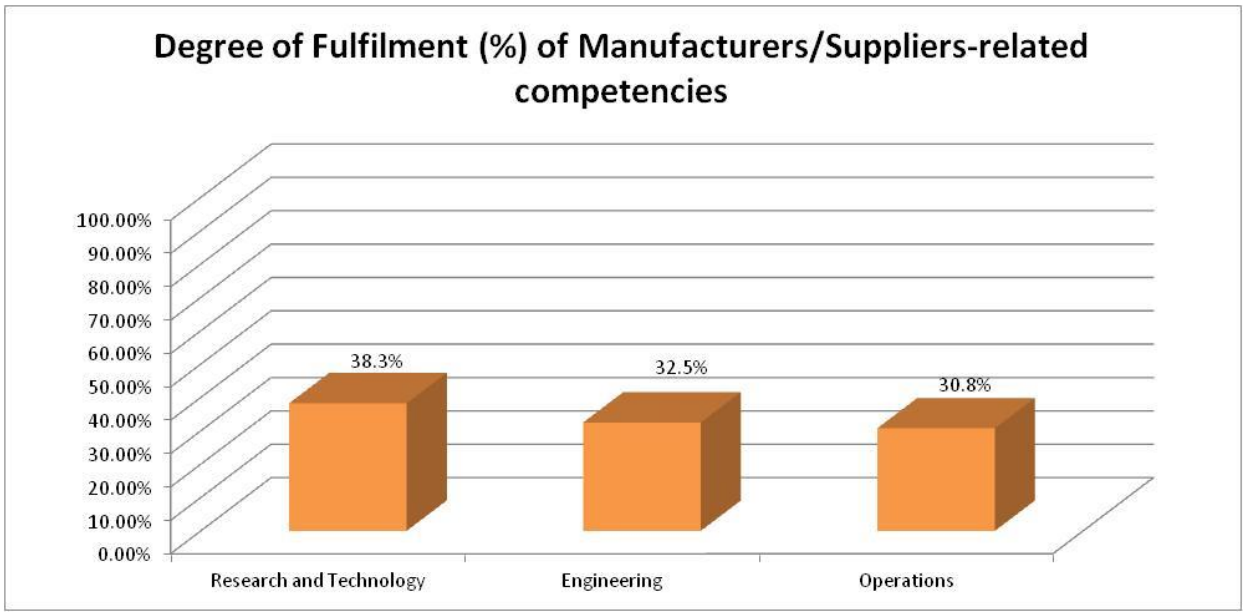


Figure 30 – Degree of Fulfilment (%) of Manufacturers/Suppliers-related Competences

Finally, the respondents were asked to indicate whether the surveyed programmes cooperate with industry along with the specific types of cooperation. Furthermore, they were asked to assess the benefits to the AAT sector as a result of various types of cooperation with the industry. All surveyed programmes (with the exception of one) have positively replied that they are engaged in certain cooperation activities with industry. The dominant type of cooperation (almost all surveyed programmes) is within the framework of research projects, with industrial internships and guest lectures being also types of cooperation that are frequently met (75-80% of surveyed programmes) (

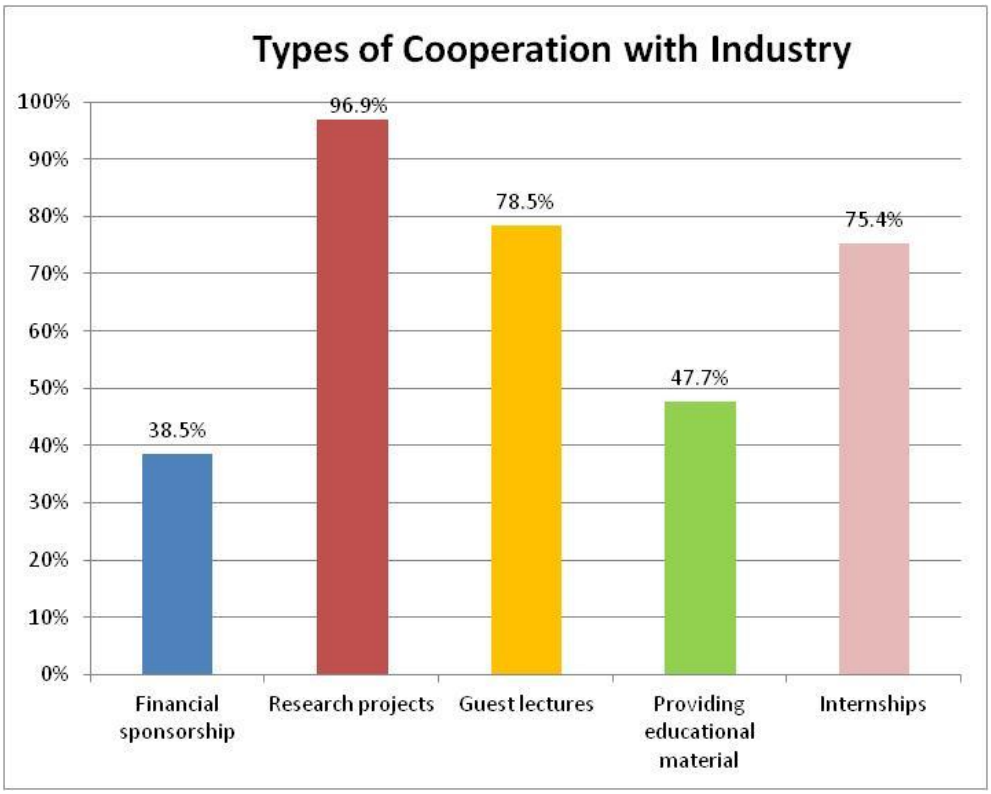


Figure 31). Financial sponsorship is less frequently mentioned as a type of cooperation with industry. Where applicable, financial sponsorship is provided most frequently in the form of

direct funding of research or funding of educational programmes (

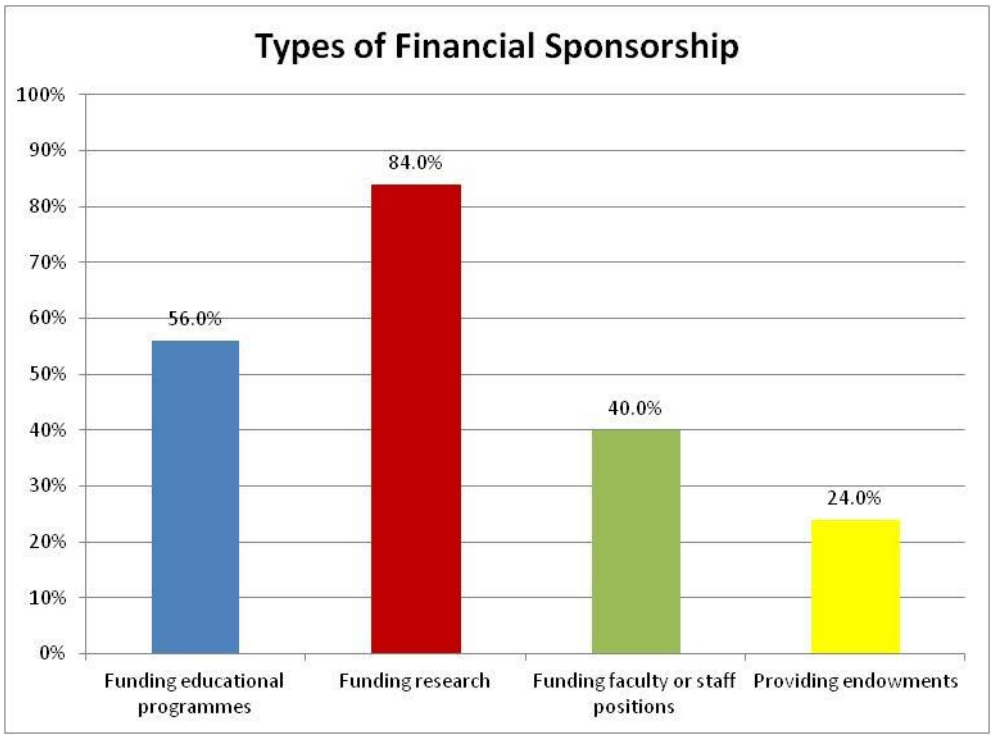


Figure 32).

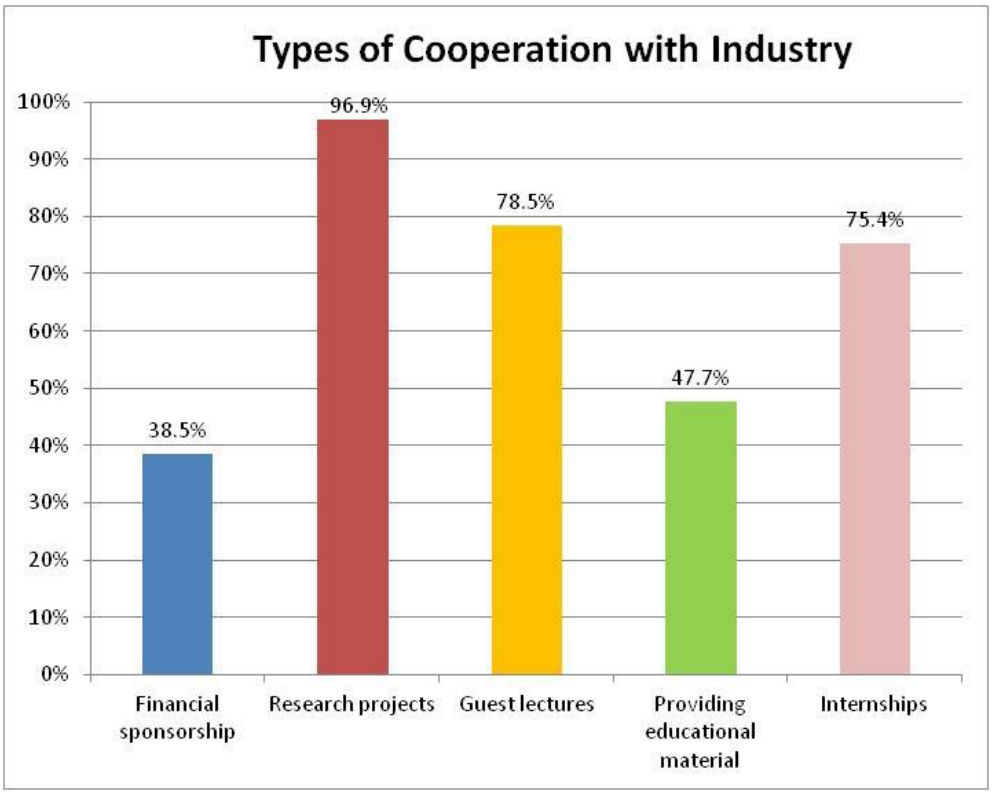


Figure 31 – Types of Cooperation with Industry

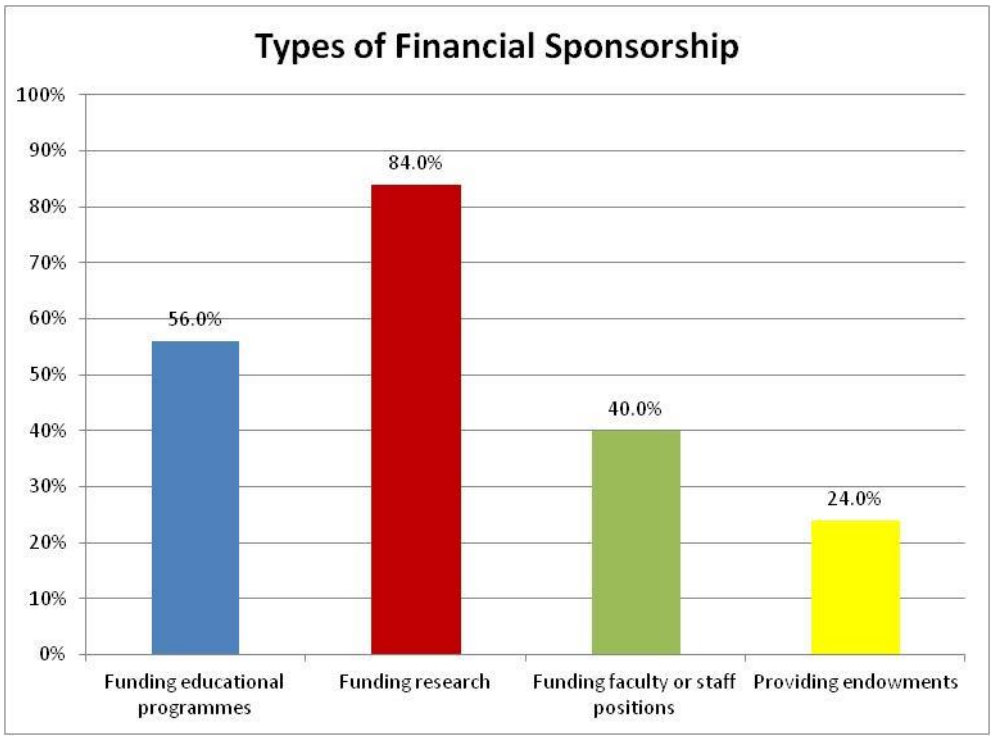
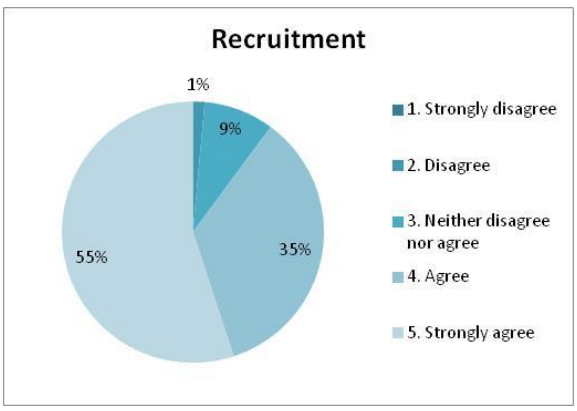
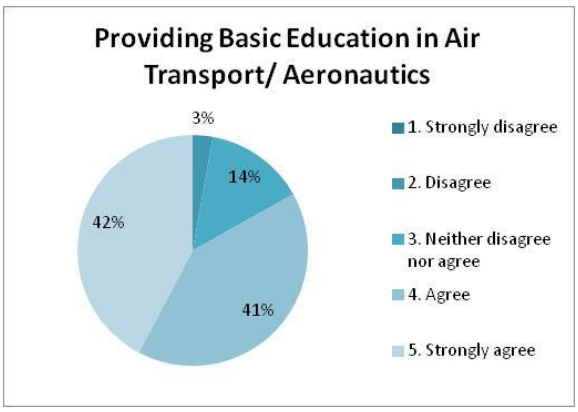


Figure 32 – Types of Financial Sponsorship

Finally, Figure 33 presents the viewpoints of surveyed faculty members on the perceived benefits of cooperation with industry in various areas. There seems to be a consensus among respondents that cooperation with industry produces benefits for the AAT sector in all surveyed areas. The most highly ranked areas of benefits are recruitment aspects (average 4.71), industry research and development activities (average 4.64), as well as the development and promotion of innovation areas / ideas (average 4.56).





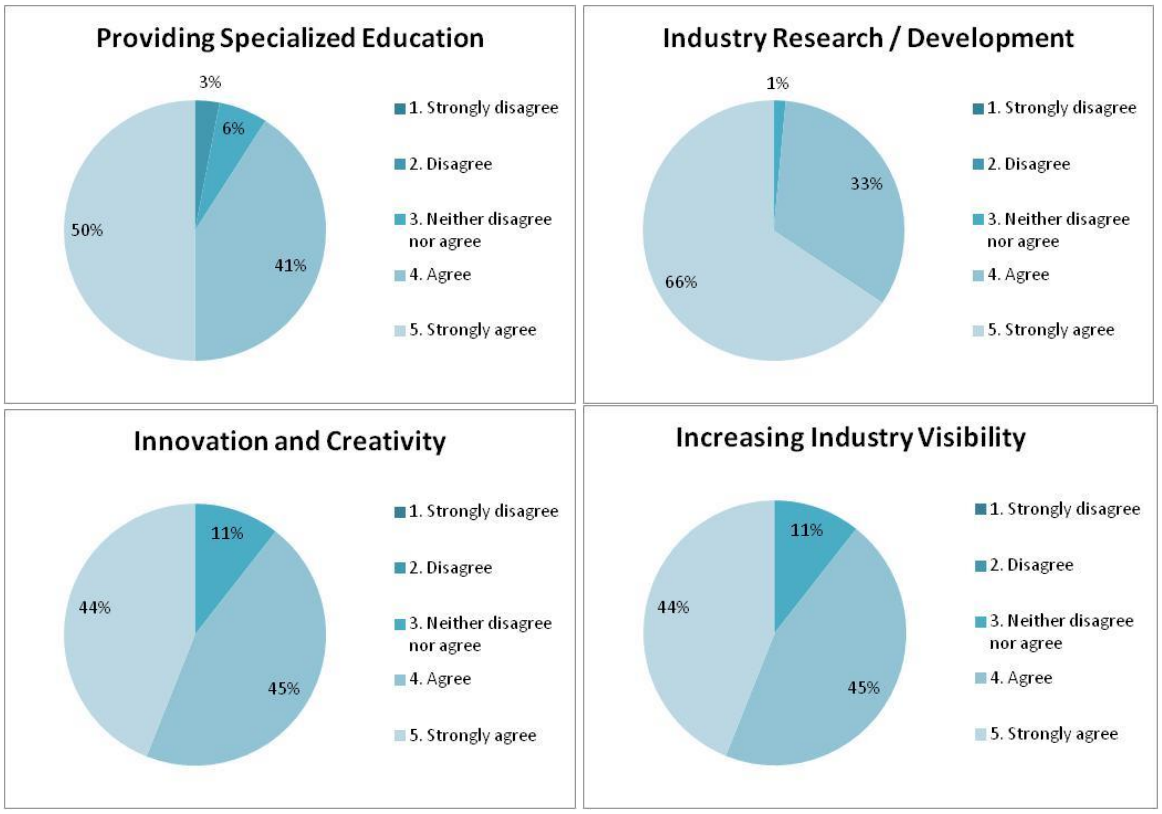


Figure 33 – Areas of Benefits of Cooperation with Industry

6 Conclusions

This document is the formal outcome of EDUCAIR/WP4 (D4.8 Deliverable) titled "Quantitative and Qualitative Assessment of Educational Supply". Its objective is threefold: i) to identify and review the existing educational offer (supply-side) in terms of relevant educational programmes (1st and 2nd Bologna Cycle) in Aeronautics and Air Transport (AAT), ii) to identify the expected portfolio of students' competences, and iii) to present and consolidate the results of the online survey and review of selected programmes offered by Educational Institutes / Universities.

The first major part of the deliverable deals with the identification and review of relevant educational programmes in Aeronautics and Air Transport (AAT) by means of a case study approach. The main objective of this review was to identify the existing educational offering (list of relevant programmes). The primarily targeted educational programmes were engineering programmes in EU27 at 1st and 2nd Bologna cycles. Furthermore, MEng programmes covering simultaneously both 1st and 2nd Bologna cycles were also considered. The list of (engineering) programmes was enriched with undergraduate and graduate programmes in AAT with management (e.g., air transport / aviation management, airport planning and management, airline management) or other relevant orientation (e.g., air safety, aviation technologies, aircraft maintenance, flight operations). Overall, the existing educational offering contains 251 educational programmes offered by 106 Universities / Educational Institutes at 22 European countries. Based on the review of selected programmes, some preliminary estimates of the numbers of engineering students - especially those graduating on an annual basis - have been made. These can provide a starting basis for a first approximation of the pool of engineering graduates (prospective employees) who enter the job market and compete for jobs in the sector on annual basis. Based on several assumptions (e.g., targeted sample of Universities and programmes, average numbers of students, overlapping between 1st and 2nd cycle graduates) that should be treated with caution, it is estimated that the overall population of aerospace/aeronautical engineering graduates at both cycles should be between 9.000 and 10.000 graduates in 2012.

The second major part of this deliverable deals with the Universities' Survey. It involves an online survey of academic staff / faculty members and programme directors / coordinators or heads of departments from academic educational programmes of all 3 Bologna Cycles with emphasis on the 1st and 2nd cycle engineering programmes in AAT. The Universities' survey has received 80 fully completed and applicable online questionnaires from 51 different

Universities at 18 countries (16 of which in EU 27). The ultimate objective of this survey was to obtain an aggregate picture of the expected portfolio of student competences that the educational institutions aim to provide to their students as input to the gap assessment exercise in WP8.

Based on the analysis of the surveyed faculty members, it can be concluded that manufacturers/suppliers-related competences are well balanced and the most frequently covered by the surveyed programmes. The most frequently taught topics pertain to fluid mechanics and acoustics, propulsion, structural design, manufacturing engineering and maintenance, materials and processes, systems engineering and architecture, airworthiness and certification, flight physics, as well as configuration management. Other manufacturers/suppliers-related topics that are under-represented in the surveyed programmes include customer service, risk management, aircraft operability and design maturity integration, composites design and stress, as well as electrical design / integration. On the other hand, airport-related and ATC/ATM-related competences were found to be partially covered / taught in surveyed programmes. As far as airport-related competences are concerned, the most frequently taught competences pertain to airport operations, as well as infrastructure planning and design. Competences related to infrastructure building and construction exhibit the lowest frequency probably because this is the core subject of civil engineering departments / programmes. Other topics suggested by respondents include airport marketing and economics, Airport Collaborative Decision Making (CDM), energy and carbon footprint management, airport safety and security, as well as emergency planning and crisis management.

Regarding the ATC/ATM-related competences, the most frequently taught topics relate to the design, development and evaluation of ATC procedures, the management of air traffic capacity and efficiency, and the supervision and planning of approach operations, whereas topics that are under-represented are those typically offered by specialized license programmes for controllers (e.g., approach control, tower and ground movements control, interaction between controllers and the operational environment). Other topics suggested by respondents include the assessment and management of environmental capacity constraints and the full-scale implementation of reduced separation minima. In line with the review of existing educational curricula ("typical profile"), where airline topics / course modules were found to be hardly available, airline-related competences were found to be poorly represented in surveyed programmes as well. Cockpit crew-related competences and competences related to planning, control and ICT are the most frequently taught topics. The emphasis is on radio navigation and communication, management of technical aspects, safety

management, planning and coordination of airline operations, as well as coordination of maintenance. On the other hand, ramp planning and flight dispatching topics are hardly covered. The least covered high-level competence is the one related to airline technics and engineering with a very limited coverage of competences related to maintenance and repairing of auxiliary systems, on board instruments, as well as navigation and radio communication equipment. Other airline-related competences suggested by surveyed faculty members are related to crew scheduling and rostering, as well as airline marketing and management.

Respondents were also asked to assess the quantity of existing educational programmes. Overall, it is concluded that there are enough engineering programmes at all 3 cycles and general management / business economics programmes at the 3rd cycle. Fewer programmes are available on law and economics/public policy studies at the 3rd cycle. Furthermore, the respondents suggested other programmes or courses that can be developed such as aerospace system dynamics, safety enhancing liability processes, process reengineering, foresight environment policy, system design and innovation, as well as aviation law and deregulation. As far as engineering programmes are concerned, the majority of respondents considered that existing programmes are sufficient, therefore, future improvement efforts may be focused on the update / restructuring of educational curricula of existing programmes so that they can better match with industry needs in terms of competence requirements.

The analysis presented in this deliverable provides an overview of the supply-side with particular emphasis placed on the existing educational offering and the expected portfolio of student competences that the Educational Institutes / Universities aim to provide to their students. Further processing and comparison of results between the respective groups of stakeholders (e.g., Universities, Students, Companies, Employees) will be subsequently performed within WP8 in order to identify mismatches - or competence gaps - between the needs (demand) for competences and the offer (supply) of educational programmes aiming to build such competences.

Finally, the rapidly evolving environment in the AAT sector poses continuously changes and new human resource requirements affecting the demand of professional competences for working in the sector. Universities and other educational institutes are asked to keep their programmes up-to-date and enrich their educational curricula accordingly. Due to dynamic industry changes, there is a serious risk that, if competence gaps are not be efficiently

addressed by the educational institutions, then these will be further magnified hence eventually affecting the competitiveness of the sector in its entirety. Therefore, it is highly advisable that such studies (like the one performed within EDUCAIR project) will be periodically updated in order to identify convergence or divergence of the competence gaps.

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8 Appendices

This section presents the various data collection templates, survey instruments and other supporting information collected within the framework of WP4. In particular, it contains:

- the template used for the review of selected academic educational programmes (1st and 2nd Bologna cycle) offered by Universities (Appendix 8.1),
- the template used for the review of selected LLL/CPD programmes offered by key industry actors or university-industry alliances (Appendix 8.2), and
- the survey instrument used for the online survey to Universities (Appendix 8.3).

Finally, Appendix 8.4 provides the complete list of European LLL/CPD programmes, while Appendix 8.5 presents the list of surveyed Universities.

8.1 Template for the Review of University Programmes

ASSESSING THE EDUCATIONAL GAPS IN AERONAUTICS AND AIR TRANSPORT

Project start Date: November 1st, 2011 – **Project Duration:** 18 months

Contract Number: 284899
Coordination and support action
(AAT.2011.7-22)
SEVENTH FRAMEWORK PROGRAMME

EDUCATION REVIEW (UNIVERSITIES)

REVIEW TEMPLATE

WORK PACKAGE 4

QUANTITATIVE AND QUALITATIVE ASSESSMENT OF EDUCATIONAL SUPPLY IN THE AIR TRANSPORT AND AERONAUTICS SECTORS

AUEB-RC/TRANSLOG

Partner Responsible: AUEB-RC/TRANSLOG
Version: v2
Date: October 1, 2012

EDUCATION REVIEW - Universities

This template has been developed by AUEB-RC/TRANSLOG in order to be used for the purposes of the review that is conducted within the framework of WP4 (Quantitative and Qualitative Assessment of the Educational Supply in the Air Transport and Aeronautics Sectors) of the EU-funded FP7 EDUCAIR project ("Assessing the EDUCational Gaps in Aeronautics and AIR Transport"). The objective of the EDUCAIR project is to improve the match between needs in human resources in the European air transport and aeronautics sector and the educational and training offer. More information about the EDUCAIR project can be found on the project website: http://www.educair.eu/

The review of the educational supply primarily targets Universities and aims to review the educational curricula of engineering programmes involving explicitly a degree in air transport/aeronautics (1st and 2nd Bologna Cycle).

The review is structured into three parts. The first part contains general questions aiming to specify the identity of the reviewer organization / partner and individual expert along with the corresponding review assignment within EDUCAIR/WP4. The second part addresses the educational offer, structure and the various constituents of the programme under review, while the third part includes questions related to generic aspects / issues of the reviewed programme.

PART 1: REVIEWER & ASSIGNMENT

1. EDUCAIR WP4 Partner / Reviewer:

   _____

2. Name & Email of the Reviewer:

   _____

3. Name of Educational Institution (assigned for review):

   _____

4. Country:

   _____

5. Additional sources / contacts (e.g., interviews) used to collect the requested information:

   _____

PART 2: EDUCATIONAL OFFER

6. Please specify the type of education related to air transport/aeronautics provided by the institution.
   - ❑ A Bachelor program
     Please specify: _____
     _____
   - ❑ A Master program
     Please specify: _____
     _____

7. What is the title of the program?

   _____

8. What is/are the Department(s) involved / offering the program?

   _____

9. What is the type of the program?
   - ❑ 1st Bologna cycle
   - ❑ 2nd Bologna cycle
   - ❑ Lifelong Learning (LLL) program
   - ❑ Professional program (CPD)
   - ❑ Other, please specify:

   _____

10. What is the type of degree awarded?
    - ❑ BA
    - ❑ BSc
    - ❑ BEng
    - ❑ MSc
    - ❑ MEng
    - ❑ Other, please specify:

    _____

11. What is the program structure?
    - ❑ 1 year
    - ❑ 2 years
    - ❑ 3 years
    - ❑ 4 years
    - ❑ 2+3 years
    - ❑ 3+2 years
    - ❑ Full 5-year
    - ❑ Other, please specify:

    _____

12. What is(are) the language(s) in which the program is offered?

    _____

13. How many students are annually enrolled (on average) in the specific program?

    _____

14. How many students graduate annually (on average) from the specific program?

    _____

15. How many (percentage) of the students are international?

    _____

16. Which are the student recruitment / selection criteria?
    - ❑ Exams – please specify: ……
    - ❑ GPA (from previous cycle studies)
    - ❑ Interview(s)
    - ❑ Motivation letter
    - ❑ Recommendation letter(s)
    - ❑ Working experience
    - ❑ Qualifications test(s) – please specify: ……..
    - ❑ Certificate(s) of Language(s) – please specify: ……

- ❑ Other, please specify:

_____

17. Are there any specializations offered by the program?
    - ❑ Yes (please specify)

      _____
    - ❑ No

18. Which are the requirements for obtaining the degree?
    - ❑ Courses
    - ❑ Thesis
    - ❑ Industrial training / internship
    - ❑ Final Year Project
    - ❑ Other, please specify:

    _____

19. How many courses / ECTS credits are required for obtaining the degree?

    Number of courses: _____

    Number of ECTS credits: _____

20. Please provide the list of courses offered by the program.

Course Titles[12]	C: Compulsory E: Elective	Number of ECTS credits or % of Total Hours	Semester or Year
Please specify the course titles below:			
……			
……			
……			
……			
……			

[12] Add rows as necessary

Course Titles[12]	C: Compulsory E: Elective	Number of ECTS credits or % of Total Hours	Semester or Year
……			
……			
……			
……			

21. What is the number of faculty / teaching staff involved in the program?

    _____

    Of which those involved in core aeronautics / air transport educational (teaching / research) activities

    _____

PART 3: OTHER ISSUES / ASPECTS

22. Please specify any accreditation labels / certifications featured by the program.

    _____

    _____

23. Please describe below any other interesting / innovative elements or best practices adopted by the program (e.g., innovative pedagogical methods, excellence awards / distinctions, Advisory Board, links with industry).

    _____

    _____

24. Is there any cooperation with companies in the air transport/aeronautics sector?

- ❑ Yes

What kind of cooperation?

- ❑ Research projects
- ❑ Guest lectures
- ❑ Providing educational material
- ❑ Internships
- ❑ Financial sponsorship
- ❑ Funding educational programs
- ❑ Funding research
- ❑ Funding faculty or staff positions
- ❑ Providing endowments
- ❑ Other; please specify

_____

- ❑ No

8.2 Template for the Review of LLL/CPD Programmes

ASSESSING THE EDUCATIONAL GAPS IN AERONAUTICS AND AIR TRANSPORT

Project start Date: November 1st, 2011 – **Project Duration:** 18 months

Contract Number: 284899
Coordination and support action
(AAT.2011.7-22)

SEVENTH FRAMEWORK PROGRAMME

EDUCATION REVIEW (LLL PROGRAMS)

REVIEW TEMPLATE

WORK PACKAGE 4

QUANTITATIVE AND QUALITATIVE ASSESSMENT OF EDUCATIONAL SUPPLY IN THE AIR TRANSPORT AND AERONAUTICS SECTORS

TRANSLOG/DUT

Partner Responsible: DUT

Version: v1.3

Date: November 6, 2012

EDUCATION REVIEW – LLL/CPD Programmes

This template has been developed by DUT/TRANSLOG in order to be used for the purposes of the review that is conducted within the framework of WP4 (Quantitative and Qualitative Assessment of the Educational Supply in the Air Transport and Aeronautics Sectors) of the EU-funded FP7 EDUCAIR project ("Assessing the EDUCational Gaps in Aeronautics and AIR Transport"). The objective of the EDUCAIR project is to improve the match between needs in human resources in the European air transport and aeronautics sector and the educational and training offer. More information about the EDUCAIR project can be found on the project website: http://www.educair.eu/

The review of the educational supply primarily targets Life Long Learning (LLL) and Continuous Professional Development (CPD) training programmes and aims to review the relevant educational offering involving explicitly a degree in air transport/aeronautics.

The review is structured into three parts. The first part contains general questions aiming to specify the identity of the reviewer organization / partner and individual expert along with the corresponding review assignment within EDUCAIR/WP4. The second part addresses the training offer, structure and the various constituents of the programme under review, while the third part includes questions related to generic aspects / issues of the reviewed programme.

PART 1: REVIEWER & ASSIGNMENT

1. EDUCAIR WP4 Partner / Reviewer:

   _____

2. Name & Email of the Reviewer:

   _____

3. Name of Educational Institution (assigned for review):

   _____

4. Country:

   _____

5. Additional sources / contacts (e.g., interviews) used to collect the requested information:

   _____

PART 2: EDUCATIONAL OFFER

6. Please specify the type of education related to air transport/aeronautics provided by the institution.
   - ❑ Lifelong Learning (LLL) program
     Please specify: _____
     _____
   - ❑ Professional courses (e.g., Continuous Professional Development – CPD)
     Please specify: _____
     _____

7. What is the title of the program?
   _____

8. Which Organization(s) is / are involved / offering the program? Please specify the type of the organization.
   _____

9. What is the type of the program?
   - ❑ 1st Bologna cycle
   - ❑ 2nd Bologna cycle
   - ❑ Lifelong Learning (LLL) program
   - ❑ Professional program (CPD)
   - ❑ Other, please specify:
     _____

10. What is the type of degree awarded?
    - ❑ BA
    - ❑ BSc
    - ❑ BEng
    - ❑ MSc
    - ❑ MEng
    - ❑ Other, please specify:
      _____

11. Which are the requirements for obtaining the degree?

- ❑ Attendance
- ❑ Exam
- ❑ Industrial exercise
- ❑ Pre-course work
- ❑ Other, please specify:

_____

12. What is the program structure?
    - ❑ Less than 1 week
    - ❑ 1 week
    - ❑ 2 weeks
    - ❑ 12 weeks
    - ❑ 1 year or 2 years full-time
    - ❑ Other, please specify:

_____

13. What is the differentiating factor of the training?

_____

14. What is (are) the language(s) in which the program is offered?

_____

15. How many students are annually enrolled (on average) in the specific program?

_____

16. How many students graduate annually (on average) from the specific program?

_____

17. How many (percentage) of the students are international?

_____

18. Which are the student recruitment / selection criteria?
    - ❑ Exams – please specify: ……
    - ❑ GPA (from previous cycle studies)
    - ❑ Interview(s)
    - ❑ Motivation letter
    - ❑ Recommendation letter(s)

- ❑ Working experience
- ❑ Qualifications test(s) – please specify: ……..
- ❑ Certificate(s) of Language(s) – please specify: ……
- ❑ Working experience (in the industry) - please specify (amount): ……..
- ❑ Working experience (outside the industry) - please specify (amount): ……
- ❑ Other, please specify:

_____

19. Who (function) is targeted to join in the training?

_____

20. From which industry are the participants:
    - ❑ Airline
    - ❑ Airport
    - ❑ Manufacturing
    - ❑ Maintenance
    - ❑ Aviation supplier
    - ❑ Consultant
    - ❑ Regulator
    - ❑ Other, please specify:

_____

21. On which functional level are the participants employed in their company?
    - ❑ Lower management
    - ❑ Higher management
    - ❑ Operations
    - ❑ Supporting
    - ❑ Other, please specify:

_____

_____

22. Are there any specializations/orientations offered by the program?
    - ❑ Yes (please specify)

_____

_____

_____

- ❑ No

23. Which are the objectives/subject areas of the program?

_____

_____

24. Which knowledge/platform is used?
    - ❑ Consultants
    - ❑ Industry
    - ❑ Research
    - ❑ Existing education program (1st and 2nd Bologna cycle)
    - ❑ Other, please specify:

    _____

25. How many courses / ECTS credits are required for obtaining the degree?

    Number of courses: _____

    Number of ECTS credits: _____

26. Please provide the list of courses/subjects offered by the program.

Course Titles[13]	C: Compulsory E: Elective	Number of ECTS credits or % of Total Hours	Semester or Year
Please specify the course titles below:			
……			
……			
……			
……			
……			
……			
……			
……			

[13] Add rows as necessary

Course Titles[13]	C: Compulsory E: Elective	Number of ECTS credits or % of Total Hours	Semester or Year
……			

27. What is the number of faculty / teaching staff involved in the program?

_____

28. Of which those involved in core aeronautics / air transport educational (teaching / research) activities

_____

PART 3: OTHER ISSUES / ASPECTS

29. Please specify any accreditation labels / certifications featured by the program.

_____

_____

30. Please describe below any other interesting / innovative elements or best practices adopted by the program (e.g., innovative pedagogical methods, excellence awards / distinctions, Advisory Board, links with industry).

_____

_____

31. Is there any cooperation with companies in the air transport/aeronautics sector?
    - ❑ Yes

    What kind of cooperation?
    - ❑ Research projects
    - ❑ Guest lectures
    - ❑ Providing educational material
    - ❑ Internships
    - ❑ Financial sponsorship
    - ❑ Funding educational programs
    - ❑ Funding research

- ❑ Funding faculty or staff positions
- ❑ Providing endowments
- ❑ Other; please specify

_____

- ❑ No

8.3 Survey Instrument for Universities

The Survey Instrument for Universities is separately attached to this document (see "Survey_Universities.pdf").

8.4 List of European LLL/CPD Programmes

Country	Organization	Type of Programme	Title	Aerospace background	Infrastructure construction (and maintenance)	Air transport management
Belgium	Belgian Flight Group	Aircraft Maintenance Mechanic	Aviation Maintenance		X	
Distant learning	IATA	Airport Training	Airport Operations		X	
eLearning	IATA	ATM Training	Airport Ramp Services		X	
	IATA	ATM Training	Aviation Security Awareness		X	
	IATA	ATM Training	Minimum Navigation Performance Specification (MNPS)		X	
	IATA	Airport Training	Basic Airside Safety		X	
	IATA	Airport Training	Pre-flight planning		X	
	IATA	CAA Training	Carbon markets			X
Europe	DLR/ESA	Research-university alliances	Radar Remote Sensing Technology and Environmental Applications	X		
France	ECATA	Industry-university alliances	Aerospace Business Integration	X		
	Airbus	Industry	Flight & cabin crew training		X	
	Airbus	Industry	Maintenance training		X	
	Airbus	Industry	Avionics & simulation		X	
	Airbussiness Academy (Airbus subsidiary)	CPD	Air Cargo Market			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Asset Management			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Cabin		X	
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Contracts			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Customisation and Standardisation			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Economics Seminar			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Evaluation			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Financing for Non-financiers			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Aircraft Operating Lease Market			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Airline Fleet Planning			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Airline Marketing			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Airline Revenue Management			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Commercial Aspects of Aircraft Maintenance		X	
	Airbussiness Academy (Airbus subsidiary)	CPD	Customer Awareness in Air Transport			X
	Airbussiness Academy (Airbus subsidiary)	CPD	New Perspectives in Aircraft Finance			X
	Airbussiness Academy (Airbus subsidiary)	CPD	Supporting the Aircraft		X	
	Enac	University	Organisation, Fonctionnement et Automatisation	X		
	Enac	University	Information de vol	X		
	Enac	University	Conception de procédures		X	
	Enac	University	Satellite-based Communication, Navigation & Surveillance		X	
	Enac	University	Architecture systèmes	X		
	Enac	University	Sécurité, audit		X	
	Enac	University	Avionique et ATM		X	
	Enac	University	Management du transport aérien			X
	Enac	University	Exploitation aéronautique			X
	Enac	University	Navigabilité des aéronefs		X	
	Enac	University	Management aéroportuaire			X
	Enac	University	Sûreté		X	

Country	Organization	Type of Programme	Title	Aerospace background	Infrastructure construction (and maintenance)	Air transport management
Germany	Nayak	Aircraft Maintenance Mechanic	Technical Training		X	
	Lufthansa	Industry-university alliances	Business Adminitstration			X
	Lufthansa	Industry-university alliances	Informatics/Business Informatics			X
	Lufthansa	Industry-university alliances	Engineering	X		
	Lufthansa Technical Training	Industry	Aviation English			X
	Lufthansa Technical Training	Industry	Aeronautical Engineering	X		
	Lufthansa Technical Training	Industry	Aviation Management			X
	DLR		Space Operations and Astronaut Training	X		
	DLR	Short course	Spacecraft Operations Course		X	
	DLR	Short course	Particle mmage Velocimetry	X		
	DLR	Short course	Direct Numerical Simulations (DNS) and Large Eddy Simulations (LES)	X		
	DLR	Short course	Application of pressure sensitive paint	X		
	University of Wildau	University	Master in Aviation Management (part-time)			X
In-company	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline, Airport and Aircraft Finance			X
	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline Commercial Perspectives			X
	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Airline Management Simulation			X
	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	EU Emission Trading Scheme (ETS)			X
	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Fleet Management and Maintenance			X
	Airbussiness Academy (Airbus subsidiary)	CPD Aviation Management	Strategic Airline Management			X
Netherlands	EASTO (JAA-TO, the International Institute of Air and Space Law of the Univ	Industry-university alliances	Aviation safety training courses		X	
	Spacetec	Delfttoptech/DUT	Post Graduate SpaceTech	X	X	X
Singapore	Singapore Aviation Academy/Insead	Industry-university alliances	Aviation Leaders Programme in Advanced Management (ALPAM)			X
Switserland	Stanford/IATA	Industry-university alliances	Stanford - IATA Aviation Management Certificate			X
	Harvard/IATA	Industry-university alliances	IATA-Harvard Leadership & Management Diploma in Aviation			X
	NTU/IATA	Industry-university alliances	IATA Nanyang Advanced Management Programme			X
	University of Geneva/IATA	Industry-university alliances	Aviation Management - IATA/University of Geneva			X
UK	Cranfield	CPD and short courses	Advanced computation methods and simulations	X		
	Cranfield	CPD and short courses	Airborne vehicle and systems	X		
	Cranfield	CPD and short courses	Aviation and the environment		X	
	Cranfield	CPD and short courses	Aviation management and operations			X
	Cranfield	CPD and short courses	Aviation safety and certification		X	
	Cranfield	CPD and short courses	Management and leadership			X
	Cranfield	CPD and short courses	Propulsion	X		
	Cranfield	CPD and short courses	Space systems and applications	X		
	Cranfield	CPD and short courses	Structures and materials	X		
	Emirates college/Coventry Univ. (UK)	Industry-university alliances	Higher National Diploma in Aerospace Engineering	X		
	Emirates college/Coventry Univ. (UK)	Industry-university alliances	Higher National Diploma in Avionics Engineering	X		
	Emirates college/Coventry Univ. (UK)	Industry-university alliances	Higher National Diploma in Electronics Engineering and Computing	X		
	Emirates college/Coventry Univ. (UK)	Industry-university alliances	Higher National Diploma in Computing Software Development	X		
	Emirates college/Coventry Univ. (UK)	Industry-university alliances	Higher National Diploma in Business Management			X
	Civil Aviation Authorities (UK)	Industry	Maintenance training		X	
	AVISA Aviation Safety Systems Ltd	Industry	Quality Assurance and Maintenance		X	
	London City University	Masters of Science	Air Transport Management			X
	London City University	Masters of Science	Air Safety Management		X	
	London City University	Masters of Science	Aircraft Maintenance Management		X	

Country	Organization	Type of Programme	Title	Aerospace background	Infrastructure construction (and maintenance)	Air transport management
World	ICAO	Industry-Association alliances	Accident Investigation and Prevention	X		
	ICAO	Industry-Association alliances	Aeronautical Information Services		X	
	ICAO	Industry-Association alliances	Aeronautical Meterorogical Services		X	
	ICAO	Industry-Association alliances	Environment		X	
	ICAO	Industry-Association alliances	Air Traffic Control		X	
	ICAO	Industry-Association alliances	Air Transport			X
	ICAO	Industry-Association alliances	Aircraft Maintenance and Airworthiness		X	
	ICAO	Industry-Association alliances	Airport Engineering and Maintenance		X	
	ICAO	Industry-Association alliances	Fire Fighting and Search and Rescue Services		X	
	ICAO	Industry-Association alliances	Aviation Management			X
	ICAO	Industry-Association alliances	Aviation Security		X	
	ICAO	Industry-Association alliances	Aeronautical Communications and Navaids Maintenance		X	
	ICAO	Industry-Association alliances	Aeronautical Communications Operations		X	
	ICAO	Industry-Association alliances	Dangerous Goods		X	
	ICAO	Industry-Association alliances	Machine Readable Travel Documents		X	
	ICAO	Industry-Association alliances	Safety Management		X	
	ICAO	Industry-Association alliances	Training Technology ins		X	
	ICAO	Industry-Association alliances	Flight Operations Services PIL		X	
	ICAO	Industry-Association alliances	Flight Calibration		X	
	ICAO	Industry-Association alliances	Airline Cabin and Support Services		X	
	ICAO	Industry-Association alliances	Language Training		X	
	ICAO	Industry-Association alliances	Civil Aviation Training Courses		X	
	ACI	Global Safety Network Training	Airport Executive Leadership Programme			X
	ACI	Global Safety Network Training	Global ACI-ICAO Airport Management Professional Accreditation Programme (AMPAP)			X
	ACI	Global Safety Network Training	Air Transportation System			
	ACI	Global Safety Network Training	Airport Commercial and Financial Management		X	
	ACI	Global Safety Network Training	Airport Operations, Safety and Security		X	
	ACI	Global Safety Network Training	Airport Master Planning, Development and Environmental Management			X
	ACI	Global Safety Network Training	Safety Management Systems		X	
	ACI	Global Safety Network Training	Airside Safety and Operations		X	
	ACI	Global Safety Network Training	Working with Annex 14		X	
	ACI	Global Safety Network Training	Aerodrome Safety Compliance and Auditing		X	
	ACI	Airport Operational Dynamics	Airside Operations		X	
	ACI	Airport Operational Dynamics	Airport Business Dynamics			X
	ACI	Airport Operational Dynamics	Airport Terminal and Landside Operation		X	
	ACI	Professional certificate course (safety)	Accident and Incident Investigation		X	
	ACI	Professional certificate course (safety)	ACI/ICAO Aerodrome Certification		X	
	ACI	Professional certificate course (safety)	Airport Safety Management Systems Implementation		X	
	ACI	Professional certificate course (safety)	Airside Safety and Operations		X	
	ACI	Professional certificate course (safety)	Apron Management		X	
	ACI	Professional certificate course (safety)	Collaborative Decision Making (CDM)		X	
	ACI	Professional certificate course (safety)	Human Factors for Airport Managers		X	
	ACI	Professional certificate course (safety)	Runway Incursion Awareness and Prevention		X	
	ACI	Professional certificate course (security)	Airport Security		X	
	ACI	Professional certificate course (security)	Baggage Screening: Operational and Image Analysis		X	
	ACI	Professional certificate course (facilitation)	Developing a Customer Service Culture at Airports: Measuring and Benchmarking the results		X	
	ACI	Professional certificate course (facilitation)	Managing Service Quality at Airports		X	
	ACI	Professional certificate course (facilitation)	Passengers with Reduced Mobility (PRM) Workshop		X	

Country	Organization	Type of Programme	Title	Aerospace background	Infrastructure construction (and maintenance)	Air transport management
	ACI	Professional certificate course (economics/commercial)	ACI/ICAO Airport User Charges		X	
	ACI	Professional certificate course (economics/commercial)	Airline Management for Airport Professionals			X
	ACI	Professional certificate course (economics/commercial)	Airport Concession Management			X
	ACI	Professional certificate course (economics/commercial)	Airport Non-Aeronautical Revenues			X
	ACI	Professional certificate course (economics/commercial)	Airport Route Development and Marketing			X
	ACI	Professional certificate course (economics/commercial)	EU Funds and Airport Financing			X
	ACI	Professional certificate course (environment)	Airport Carbon Management			X
	ACI	Professional certificate course (environment)	Airport Environment Management			X
	ACI	Professional certificate course (environment)	Global ACI/ICAO AMPAP Elective on Airport Environment Management			X
	ACI	Professional certificate course (airports)	Air Traffic Forecasting			X
	ACI	Professional certificate course (environment)	Airport Communication and Public Relations			X
	ACI	Professional certificate course (environment)	Airport Master Planning		X	
	ACI	Professional certificate course (environment)	EU Regulations for Airports		X	
	ACI	Professional certificate course (human Resource)	Airport Strategic Human Resources Management			X
	ACI	Professional certificate course (human Resource)	Airport Project Management Essentials			X
	ACI	Professional certificate course (human Resource)	Airport Enterprise Risk ManagemenT			X
	ACI	Operations and Regulatory Courses (safety)	Airside Safety Awareness Package		X	
	ACI	Operations and Regulatory Courses (safety)	Human Factors Awareness Training		X	
	ACI	Operations and Regulatory Courses (safety)	Dangerous Goods Awareness for Passenger Handling Personnel (Category 9 per ICAO Technical Instructions)		X	
	IATA	Airline Training	Air Cargo Operations Essentials			X
	IATA	Airline Training	Air Transportation Management			X
	IATA	Airline Training	Air Waybill Rating Fundamentals		X	
	IATA	Airline Training	Aircraft Weight and Balance		X	
	IATA	Airline Training	Airline Business Foundations			X
	IATA	Airline Training	Airline Passenger Services			X
	IATA	Airline Training	Airport Customer Service			X
	IATA	Airline Training	Airport Slots and Scheduling		X	
	IATA	Airline Training	Airside Operations - Safety Compliance		X	
	IATA	Airline Training	Biojet Fuel Workshop		X	
	IATA	Airline Training	Documentation Control and Passenger Assessment		X	
	IATA	Airline Training	Foundation of Risk Management			X
	IATA	Airline Training	Human Factors in Aviation		X	
	IATA	Airline Training	In-flight Security		X	
	IATA	Airline Training	IOSA Auditor Training		X	
	IATA	Airline Training	Medical Issues in Aviation			X
	IATA	Airline Training	Network, Fleet and Schedule Planning		X	
	IATA	Airline Training	Passenger Fares and Ticketing			X
	IATA	Airline Training	Passenger Proration			X
	IATA	Airline Training	Quality Management Systems (QMS) for Airlines		X	
	IATA	Airline Training	Revenue Management		X	
	IATA	Airline Training	Safety Management Systems for Civil Aviation		X	
	IATA	Airline Training	Security Management Systems - SeMS		X	
	IATA	Airline Training	Station Operations Control		X	
	IATA	Airline Training	Temperature Sensitive Cargo Handling		X	
	IATA	ATM Training	Radios and Communications		X	

Country	Organization	Type of Programme	Title	Aerospace background	Infrastructure construction (and maintenance)	Air transport management
	IATA	ATM Training	AIS		X	
	IATA	ATM Training	Introduction to Safety Management Systems (SMS)		X	
	IATA	ATM Training	Quality Management Systems for CAAs and Air Navigation Service Providers		X	
	IATA	Airport Training	Airport Security Awareness		X	
	IATA	Airport Training	Internal Audit for Ground Serviced Providers		X	
	IATA	CAA Training	Managing the Safety Oversight Function		X	
	IATA	CAA Training	Civil Aviation Management			X
	IATA	Ground handling Training	Air Waybill Rating Fundamentals		X	
	IATA	Ground handling Training	Business Aviation and FBO Ground Services		X	
	IATA	Ground handling Training	Cargo Skills and Procedures		X	
	IATA	Ground handling Training	Dangerous Goods Awareness		X	
	IATA	Ground handling Training	IATA Air Cargo Rating		X	
	IATA	Ground handling Training	IATA Cargo Introductory Course			X
	IATA	Ground handling Training	IATA Electronic Airwaybill (e-AWB)		X	
	IATA	Ground handling Training	International Cargo Operations and Documentation		X	
	IATA	Ground handling Training	ULD Handling Awareness		X	

8.5 List of Universities / Institutes Participating in the Survey

Name of Educational Institute / University
University of Limerick
Trinity College Dublin
University of Zilina
Technical University of Kosice
University of Bristol
Cranfield University
Loughborough University
University of the Highlands and Islands
Queen's University of Belfast
Manchester Metropolitan University
Imperial College London
Glasgow University
Toulouse Business School
Institut National des Sciences Appliquées de Toulouse
Paris Institute of Technology
Aix Marseille University
Ecole Nationale de l'Aviation Civile
Universidad Politécnica de Madrid
University of Las Palmas de Gran Canaria
International Center for Numerical Methods in Engineering
Autonomous University of Barcelona
University of Leuven
Université Libre de Bruxelles (ULB)
Royal Military Academy
University of Ghent
University of Beira Interior
Instituto Superior Técnico
University of Bologna
University of Pisa
Polytechnic University of Milano
University of Bologna
Polytechnic University of Torino
University of Trieste
University of Rome "La Sapienza"
University of Naples "Federico II"
University of Roma Tre
Aachen University of Applied Sciences
RWTH Aachen University
Baden Württemberg University
Polish Academy of Sciences
University West
Linköping University
Technical University of Sofia
University of Patras
University of the Aegean
University of Belgrade
Estonian Aviation Academy
Afyon Kocatepe University
Institute for Theoretical and Experimental Analysis for Aeronautical Structures
University Politehnica of Bucharest
Budapest University of Technology and Economics