Chapter 5

Designing and Developing New VET Curricula to Address Skills Gaps in the Aeronautics Industry

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Additional information is available at the end of the chapter

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Abstract

Aeronautic industry is one of the enablers of the economic development and social insertion at European level, and it is one of the drivers of expansion of remote regions as far as it allows habitants, workers, and companies at these regions to expand their activities and areas of influence. The European aeronautics industry, including the commercial air transport, generates more than 220 billion of Euros and more than 4.5 million of jobs. These figures are expected to be double by 2030. Future developments in the sector, together with greater intra-European mobility of workers and population aging, bring a greater need for new skills in the work force together with an urgency for a larger number of professionals. Therefore, to achieve the desirable sustained growth the EU needs to invest in high-quality VET (vocational education and training) in order to be able to supply the AI (aeronautic industry) with qualified workers. VET stands for education and training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly on the labor market. This work discusses the outcomes of the AIRVET project, an European partnership whose principal objective is the development and promotion of "curricula and VET courses" in the Maintenance and Information and Communications Technologies (ICT) domains, required for a highly skilled aeronautical workforce.

Keywords: vocational education training (VET), aeronautic industry, skills needs/skills gaps, curricula, multimedia resources

1. Introduction

As was recently discussed at a UK Education and Skills meeting organized by the Royal Aeronautical Society, the financial importance of the aerospace industry to the European economy is significant [1]. The aviation industry is estimated to be worth 4.5 Trillion dollars

by 2030 [2], and Airbus forecasts that in the period 2014–2033, approximately 31,000 passenger aircraft are required at a value of $4.6tr [3].

Aeronautic industry is recognized by the high-level skilled professionals it engages [4]. Main job positions involve engineers and maintenance technicians trained at the highest level. However, studies [5] show that 85% of its direct employment is concentrated in 5 EU countries, and the aging of EU population threatens the availability of qualified personnel, emerging in skill shortage sector. Some of the most important industry's problems today are related to skills gaps in current employees as well as the requirement to attract more people into the industry [6].

The industry is constantly developing technology to improve aircraft performance and the efficiency of the operation of airports and aircrafts. This need for a growing number of trained personal can be further seen in statements made by most of the large aviation companies, such as Airbus that: "… has a proactive approach to working with Universities around the world to support the development of future talent. This includes implementing strategic programs such as the Airbus University Board as well as engaging with relevant academic and student networks" [7].

To achieve the desirable sustained growth, the Aeronautic Industry highly depends on the availability of flexible and high-skilled labor force. The overall performance of Aerospace education and training must be improved and a balance between initial and continuous education and training has to be established [8].

2. Designing and developing new vet curricula to address skills gaps in the aeronautics industry

EU needs to invest in high-quality vocational education training (VET) in order to be able to supply the aeronautic industry (AI) with qualified workers [9]. EU aeronautics industry needs to be considered as a global industry rather than a national one, and mobility of workers is undeniable. A close cooperation among VET systems from different EU countries is also desirable to cope with the demands of the growing aeronautical industry:

- enhancement of the global outcomes of the learning process;
- collaboration between European VET providers and training systems;
- equilibrium between vocational training activities along the workers life; and
- effective application of knowledge and skills independently whether they have been learned in official and non-formal contexts.

The AIRVET (aeronautic industry skills resolution for a more efficient VET offer) project is a long life learning initiative financed by the European Commission to prepare industry and society to face challenges identified hereafter.

Its main objective is to **design**, **develop**, **evaluate** and **disseminate adapted/new AI curricula and VET courses** in the specific fields of maintenance and information and communications technologies (ICT).

The main results expected by AIRVET are:

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- Identification of training and **regulatory** frameworks, and **training gaps and opportunities** for the development of VET curricula and training initiatives.
- **Design of curricula and multimedia resources** for training based on innovative ways of delivering VET, e.g., learning-based games, 2D/3D graphics, low cost simulations, virtual reality, etc.
- **Delivering the curricula by developing pilot runs,** practical learning sessions in which the dynamic solutions will be tested in order to collect opinions from both the trainers and the participants on the educational programs and innovative learning approaches.

2.1. Phases and activities

AIRVET is implementing a series of activities and producing outputs for different target groups. The work plan has three main phases, summarized in **Table 1**, and includes open channels of communication through online tools and a series of events to assess the projects product with stakeholders of the industry and to disseminate the project. Project phases, outcomes, and events are summarized in **Figure 1**.

Phase	Main output	Short description
Analysis of skills needs	Territorial analysis	Collection of training needs involving the stakeholders of the sector
Curricula design	AI training curricula	AI maintenance and ICT training curricula/program
Curricula delivery	Multimedia resources	Multimedia resources for training (minimum 3) + user's guide manual

Table 1. Phases for VET improvement.

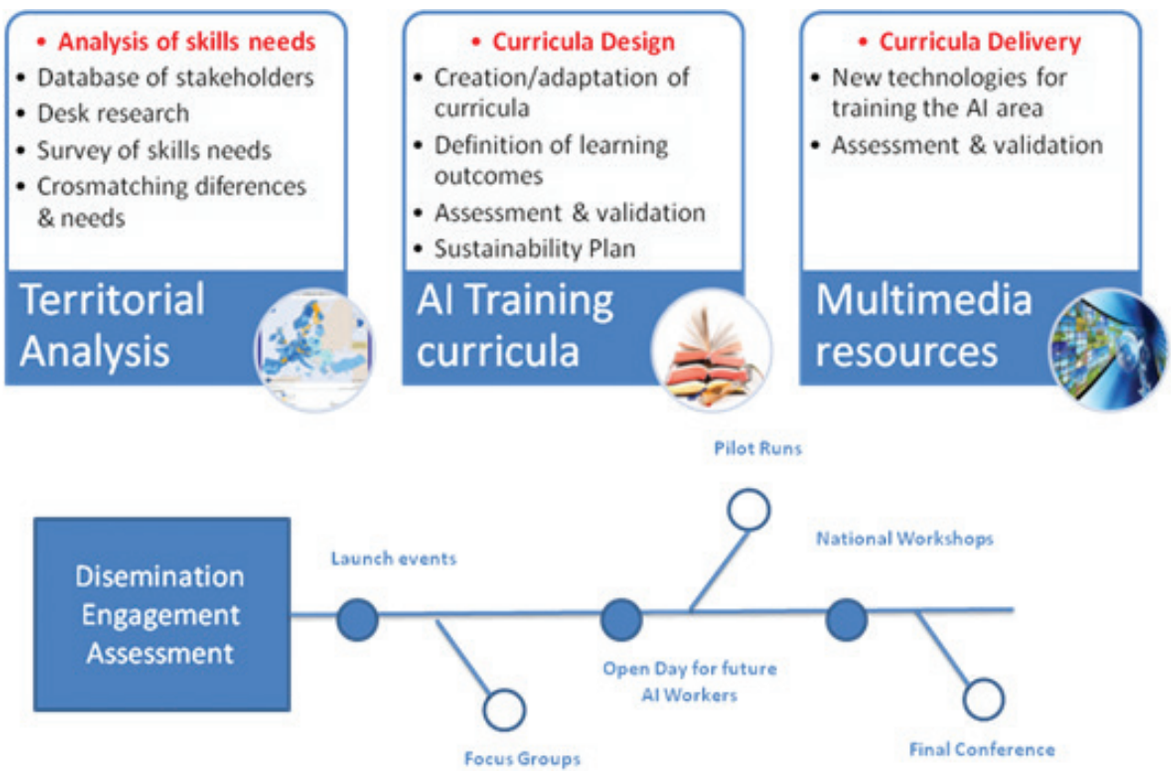

Figure 1. Phases, outcomes, and events of the AIRVET initiative.

3. Territorial analysis of skills needs

The initial outcome of the project has consisted in an extensive work to identify the training and regulatory frameworks, as well as the training gaps and opportunities for the improvement and development of VET curricula and training initiatives [10].

The methodology undertaken aimed to identify potential areas of training gaps, curricula that need to be developed or updated or training materials, where improvements could be achieved. The work carried out to investigate these issues, named "Territorial analysis," was split into three components, as illustrated on **Figure 2**:

- **a desk study** to identify and analyze the current VET programs offered in the airline industry in Europe and determine the principal EU regulations that structured the training in the aviation industry and identify skill gaps;

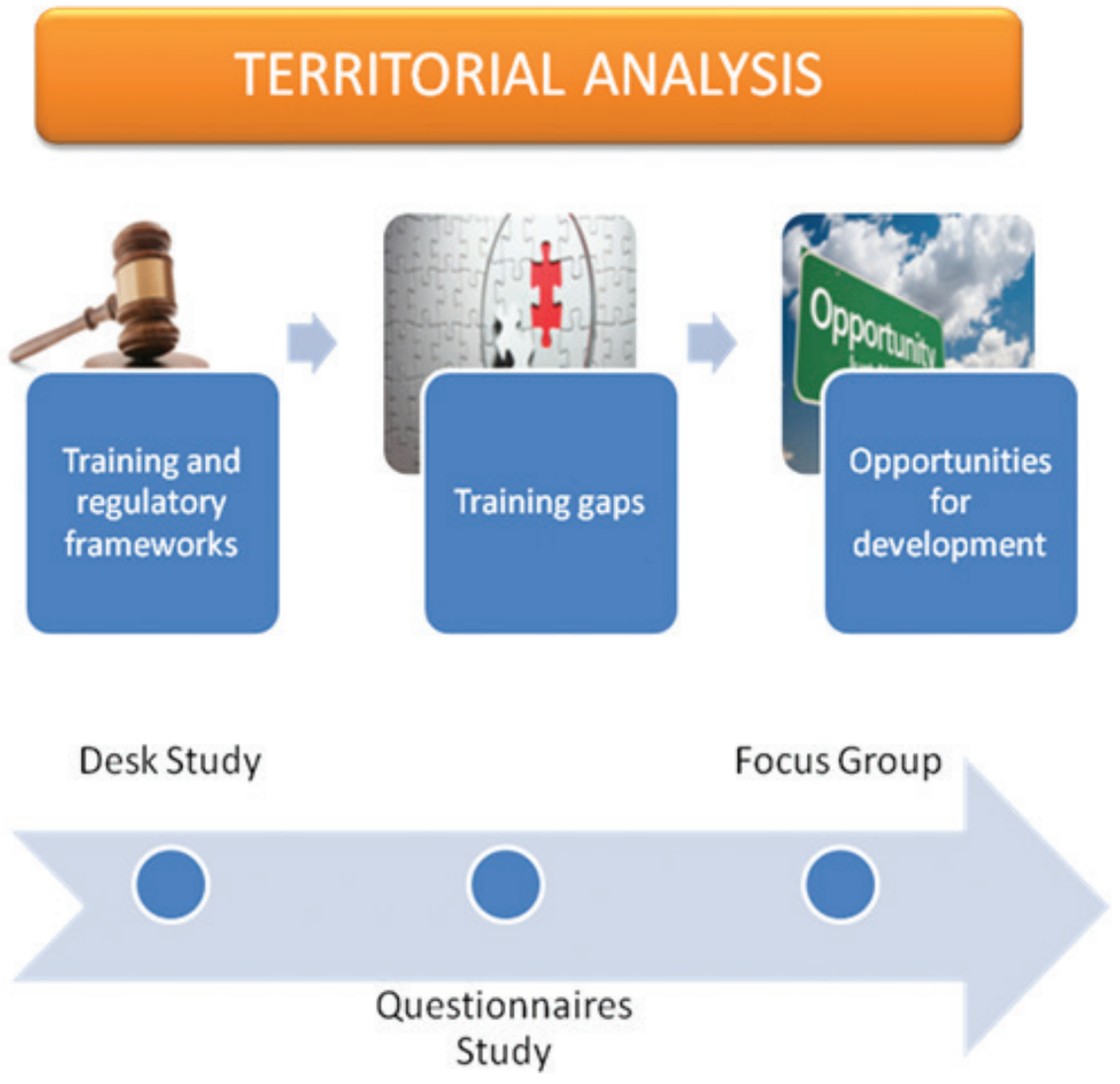

Figure 2. Phases of the Territorial Analyses of skills needs.

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- **a questionnaires study** to sought views directly from practitioners to obtain information on their views of skills needs and skills gaps, current training available, and methods of training delivery;
- **a focus groups** on skills needs study to foster face-face discussion among agents in the aviation industry using the preliminary results obtained from the desk research and questionnaire analysis.

3.1. Desk study analysis

The desk study was wide ranging and addressed many aspects of the aviation industry including air traffic management, airlines, and airport operations. It has brought the following conclusions:

- The **training of pilots and air traffic control personal** and **Cabin crew training** are highly regulated and supplemented by frequent in-house training. There was no evidence of skills gaps, which was expected in these high safety critical roles.
- For **airport operations**, although there are several international bodies that promote and endorse aviation training, there are also many roles that require unregulated training that is carried out by the airport companies. In many countries, especially those without a large aerospace industry, there are few opportunities for people to find out about the career opportunities within airports. This gap leaves potential employees uninformed about the opportunities available. The creation of **open-source training materials that could be used outside of an airport training centre may be beneficial** in increasing recruitment but also providing new employee's basic knowledge of how an airport operates.
- **Manufacturing skills** are normally obtained via an apprenticeship and countries usually have their own defined systems. It is not clear what additional training companies deliver and they rarely publish information on specialized courses they operate. The gap mainly discussed in the literature is the lack of new entrants. **Materials to inform and enthusiasm the youth to engage in apprenticeships** would be beneficial.
- The training of the **people who maintain aircrafts** is regulated at EU level. It is unlikely that this project could influence the training undertaken, but it could **produce materials that can be used to enhance training, an example being for those opting to carry out self-learning.** There were some skills gaps identified for specific aircraft types that are not common and for the new technology of electric driven aircraft.

3.2. Questionnaire study analysis

To perform the questionnaire study, stakeholders were subdivided into four categories as shown in **Figure 3**. The questionnaire was bespoke designed, as indicated in **Table 2**, considering each stakeholder group characteristics [11].

3.2.1. Survey circulation and response

An intensive survey questionnaire distribution campaign was put in place to maximize its circulation across the European aviation industry and to ensure a wide range of aviation

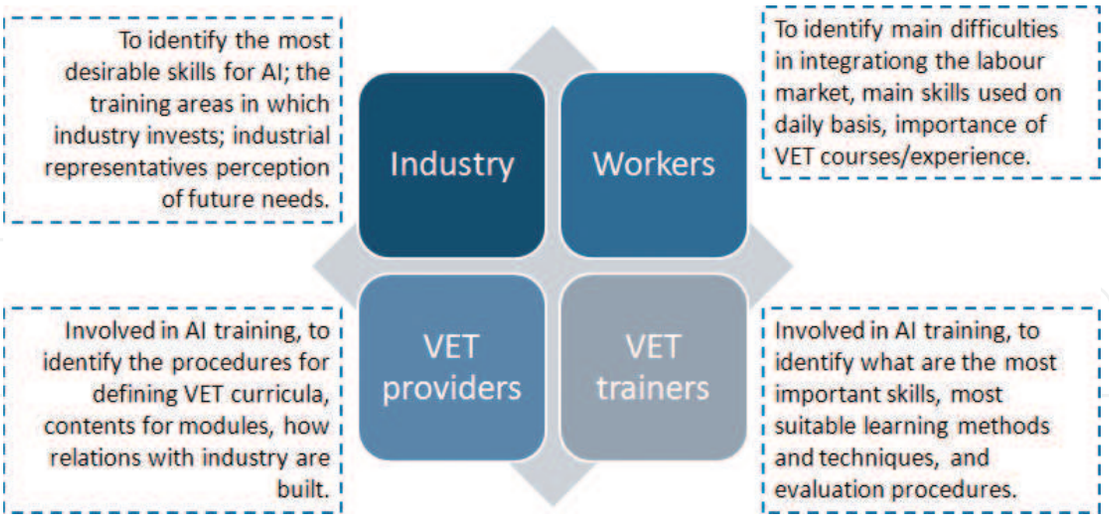

Figure 3. Stakeholder categories and specific survey areas.

Question categories	Workers	Industry (managers)	VET providers	VET trainers
Demographics				
Company background	Operating country Company size Workers role	Operating country Company size Company function	Operating country Aerospace activity	Operating country Aerospace activity
Worker background	Age Work experience Education background			
Current training information				
Training related to soft skills	Training experience	Training provision	Courses run	Courses run
Training related to technical skills	Training experience	Training provision	Courses run	Courses run
Training delivery method (tradition, CBT, blended, etc.)	Training received and preferred		Training provided	Training provided
Skill gaps and training development				
General areas of skills gaps	Training needed	Skill gaps identified	Skill gaps description	Skill gaps description
Future skills gaps identification and training development	Preferred training delivery method	Future skills gap description	Course development drivers	Course development drivers

Table 2. Set of questions pose to the different groups.

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industry workers and professionals reaction. Population been reached by the questionnaire distribution campaign it was roughly around 16,500 persons distributed as summarized in the **Table 3**, distinguishing among "**primary readers**" (persons directly reached) and "secondary readers" (resulting from circulation of the survey inside companies and institutions).

Survey demographics summarizes how the distribution of responses obtained from EU countries varied by stakeholder group. The greatest number of responses was obtained from the industry workers (81%), while 19% of the responses were received from industry mangers. Responses from VET providers and trainers were very similar. Although only two responses were obtained from UK VET providers, these were from the Aviation Skills Partnership (ASP)

Distribution medium	**Primary readers**	**Secondary readers**	**Global targets**
AIRVET Website	1000 Estimated figure through the number of visits on the web page		1000
Direct email approaches	2085 2085 emails were sent		2085
Paper copy distribution	200 Rough figure (people without access to the online questionnaires, meetings with aerospace personal, conferences and exhibitions		200
Social media	300 Estimated figure through the number of followers on social media		300
Professional organizations	Details of the AIRVET project and a request to complete the questionnaires were circulated by professional organizations such as:		
	The Chartered Institute of Logistics and Transport (UK) magazine bulletin 1030 It was distributed to all members (approximately 1030) readers.	1500 [12]	2530
	The Institution for the Development of Vocational Training for Workers (Italy) (published in the EuroGuidance newsletter) 617 members	10,000 [13]	10,617
	A stand at the "Futures Day" at 2014 Farnborough Airshow EU training organizations represented	320	352
Total number of targets reached by the questionnaire survey information	**Primary readers**	**Secondary readers**	**Total**
	5264	**11,820**	**17,084**

Table 3. Population reached by the questionnaire distribution.

and SEMTA, which are the two key bodies. The majority of responses were obtained from the partner countries (95% of the responses). Response rates in France, Portugal, and the UK were fairly even (6–9%), while responses from Italy were slightly higher (12%). The majority of responses from industry workers and managers were from people working in large companies with greater than 200 employees (39% and 59%, respectively). Representation from small companies was only 11% and 10%.

Responses from both, the workers and managers survey indicate coverage from at least a dozen aerospace sectors (**Figure 4**). Interviewed VET providers and trainers, 67% of respondents indicated that more than 50% of their training was carried out in the aerospace sector.

Based on industry data [14], it was concluded that the proportion of responses between managers and workers obtained through the questionnaire was similar to that existing within European companies. In European industry, the distribution between managers and workers accounts to approximately 7% managers and 93% workers. In the survey, the results show that the 12.5% of the people asked were managers and the 87.5% of them workers.

Nevertheless, the survey could give a bit-biased overview of the whole industry because there were countries with a strong aerospace industry, like Germany, France, or United Kingdom with little representation in the survey, and countries with a weak aerospace industry with have had a larger representation in the responses, like the case of Poland (see **Table 4**).

In other terms, according to the responses obtained in the questionnaire concerning worker's qualification, 74% of people who answered the questionnaire have a university degree, 14% have college education, 6% school education, and 6% other. When comparing this to the actual situation of the industry, in the European aerospace sector, the percentages are quite different. Only 38% of workers have university education, while 41% of them have technical education and 21% have other education.

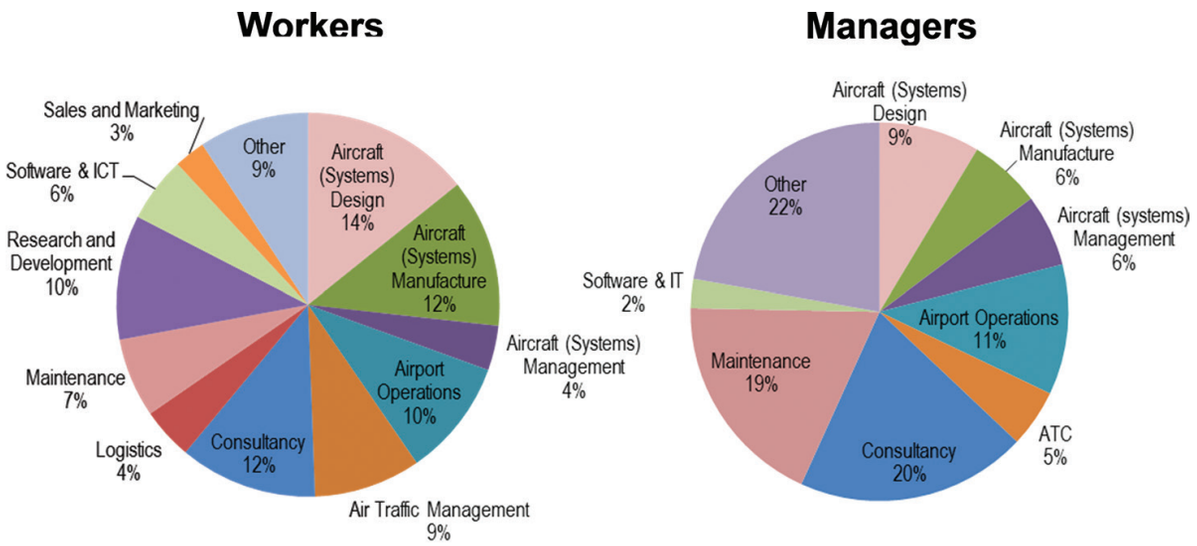

Figure 4. Distribution of aircraft industry companies responding to survey.

Country	Respondents	% of total	×1000 employees in the sector	% of total
The Netherlands	3	0.58	15.77	3.14
Spain	86	16.57	38.13	7.59
France	20	3.85	143.2	28.49
U.K.	35	6.75	103.78	20.65
Poland	200	38.53	14.05	2.80
Italy	24	4.62	41.6	8.28
Portugal	30	5.78	5	0.99
Germany	6	1.16	95.08	18.92
Sweden	1	0.19	8.25	1.64
Others	114	21.97	37.74	7.51

Table 4. Relationship between weight of responses obtained and real participation of labor force in the aeronautical industry by country.

3.2.2. Training experiences

The majority of aircraft industry workers have attended job's related training courses in the last 3 years (96%). Of these training events, workers reported that 48% were in subjects related to soft skills and 52% in technical areas as illustrated in **Figure 5**.

Of the soft skills training received, the highest reported area was health and safety (20% of courses attended). Team working, communication skills, data protection, general, project, and risk management were the next popular and ranged between 7 and 12% of courses. This distribution was very similar to that provided by the management, with 13% of the courses provided in health and safety and team working, communication skills, data protection, general, project and risk management each accounting for 8–11% of provision (see **Figure 6**).

Training in soft skills is delivered by both VET providers and trainers. However, while 43% of courses delivered by VET providers are in soft skills, only 32% of courses delivered by VET trainers are in soft skills, as can be seen in **Figure 7**.

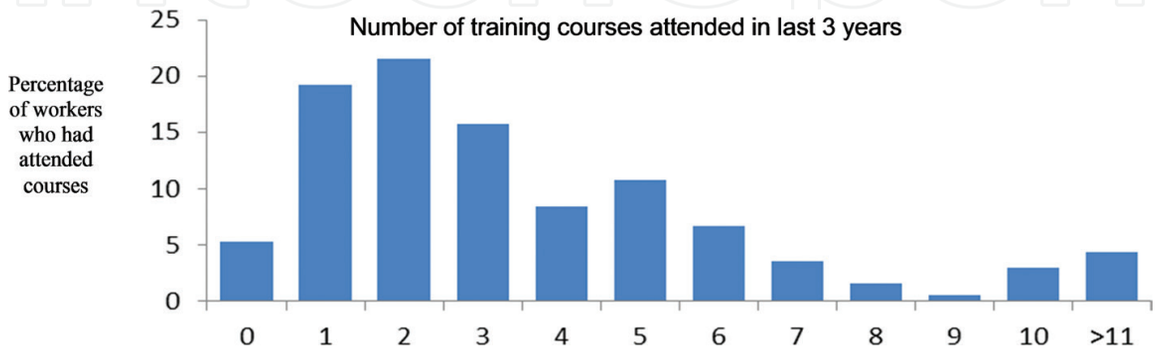

Figure 5. Number of training courses attended by workers over the last 3 years.

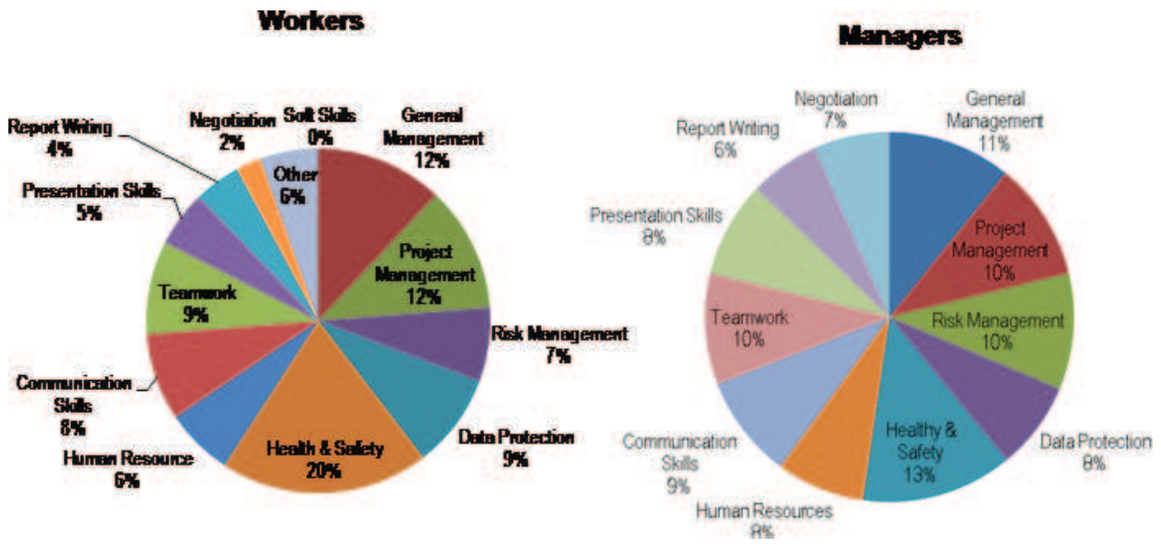

Figure 6. Distribution of soft skills training courses attended by workers and provided by managers.

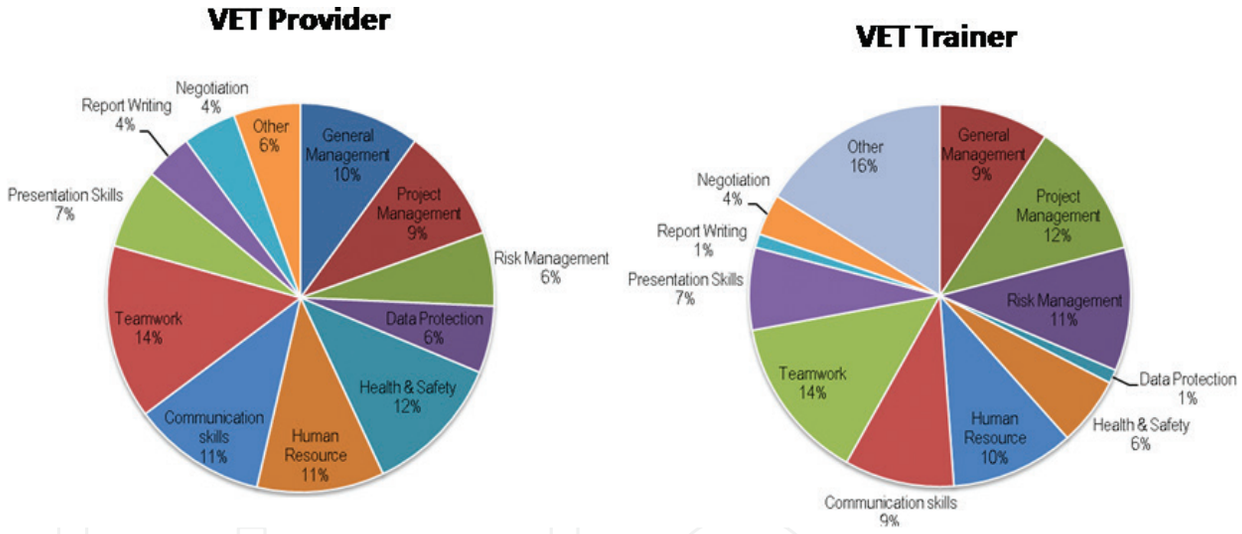

Figure 7. Distribution of soft skills training courses provided by VET providers and VET trainers.

Technical skills courses attended by industry workers were fairly evenly distributed across the categories surveyed, as can be observed in **Table 5**. Courses related to safety, security, and human factors were most frequently attended. This was reflected by the training courses being provided by management.

The distribution of courses delivered by VET providers and VET trainers in technical skills are shown in **Figure 8**. Course provision was rather evenly distributed across the categories surveyed. Aircraft regulation and maintenance accounted for a major percentage of courses provided (19% providers, 22% trainers). In terms of specific subjects, human factor training was the largest provision in both groups (providers 11% and trainers 9%).

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Technical skills	Total number of courses undertaken by workers	Total number of courses offered by management
ICT maintenance/logistics services	51	15
Workshop practice	56	30
Human factors	95	45
CAD/CAM	22	31
Stress analysis	29	28
Aircraft design	45	10
Cargo handling systems	20	13
Aerodynamics	32	19
Airport emergency procedures	43	31
Aircraft ground handling systems	26	26
Airport/aircraft regulations	66	41
Aircraft maintenance procedures	38	35
Aircraft maintenance equipment	25	29
Air traffic control	55	25
Aircraft manufacturing	20	15
Airport operations	44	31
Airworthiness	46	39
Research and development	43	24
Safety	105	54
Security	51	46
Other	62	

Table 5. Technical skills training courses provided by industry management and attended by workers.

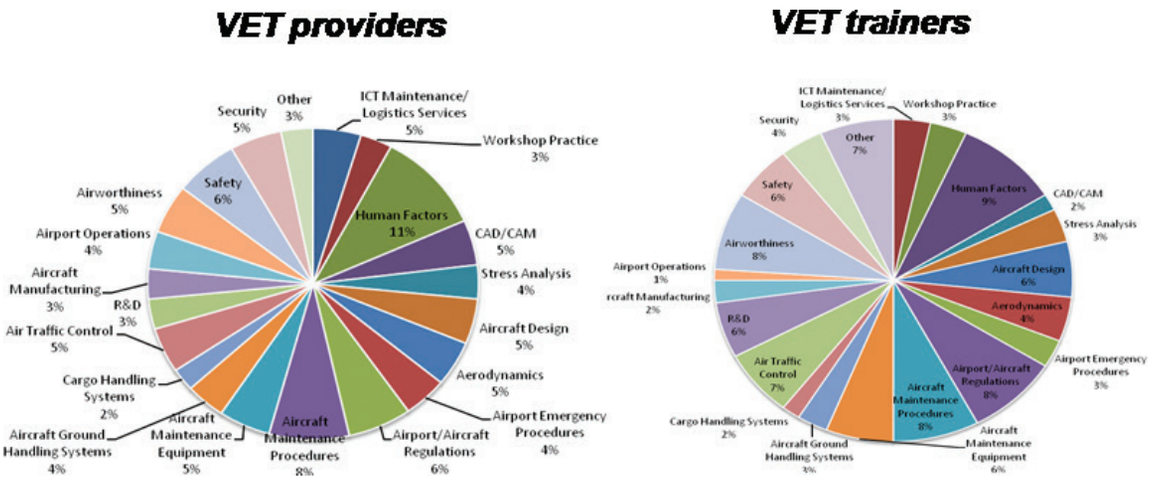

Figure 8. Distribution of technical skills training courses provided by VET providers and trainers.

3.2.3. Current possible skills gaps: Identification and training development

The areas of training gaps identified by the managers are shown in **Figure 9**. The top four predefined list categories are:

- ICT maintenance/logistics.
- Airport emergency procedures.
- Air traffic control.
- Ground handling systems.

The skills gaps results shown in **Figure 10** identify the subject areas where VET providers and VET trainers have emphasized the need for training materials. The majority of VET providers believed there is a requirement for maintenance equipment and ICT documentation with an equal percentage for the other common themes.

The majority of VET trainers identified human factors as the most significant subject area. ICT maintenance and ATSEP were mentioned in several areas including air navigation and baggage handling indicating the diverse interpretation of this term.

In addition to asking the four groups what they thought were current and future skills gaps, the VET providers were asked what the drivers for the development of new courses were. **Figure 11** shows that the majority of the training development (42%) is influenced by requests from the customer/industry. The next largest driver is market research (18%).

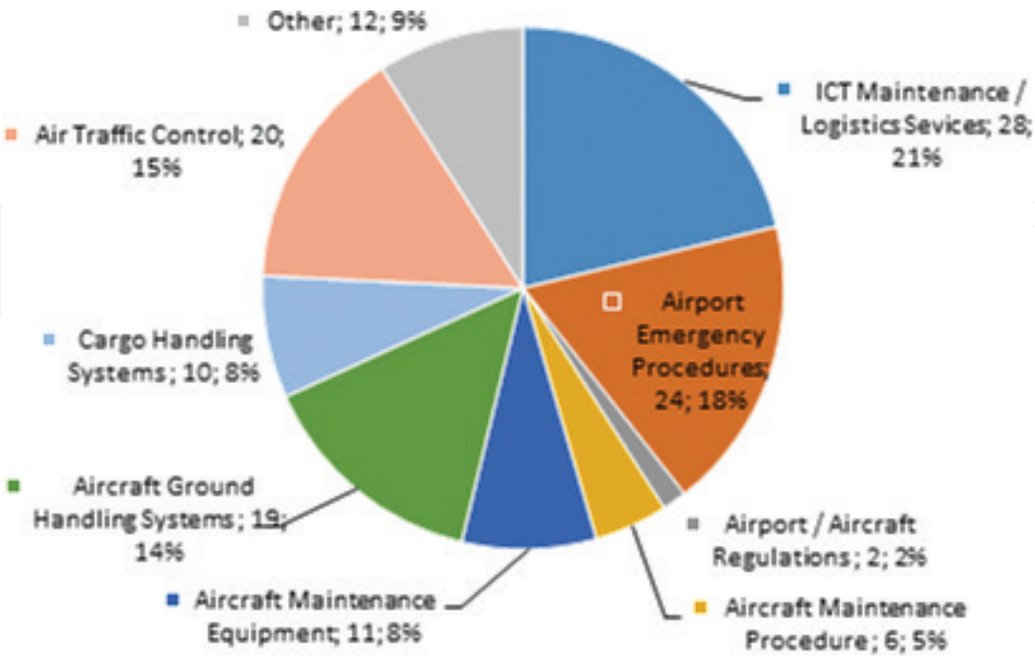

Figure 9. Areas of current skills gaps identified by industry managers.

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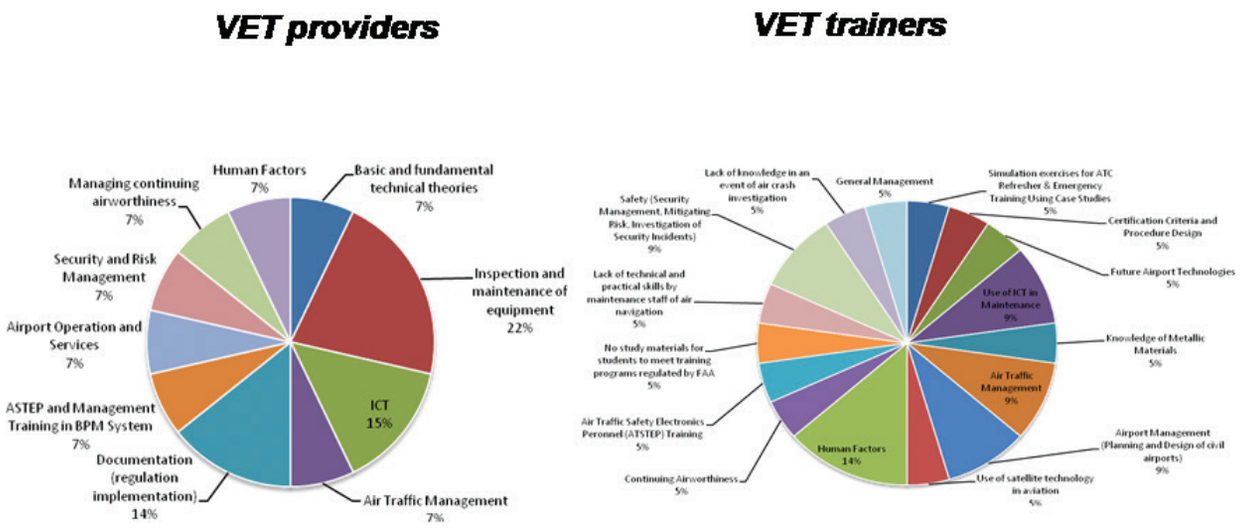

Figure 10. Areas of current skills gaps identified by VET providers and VE trainers.

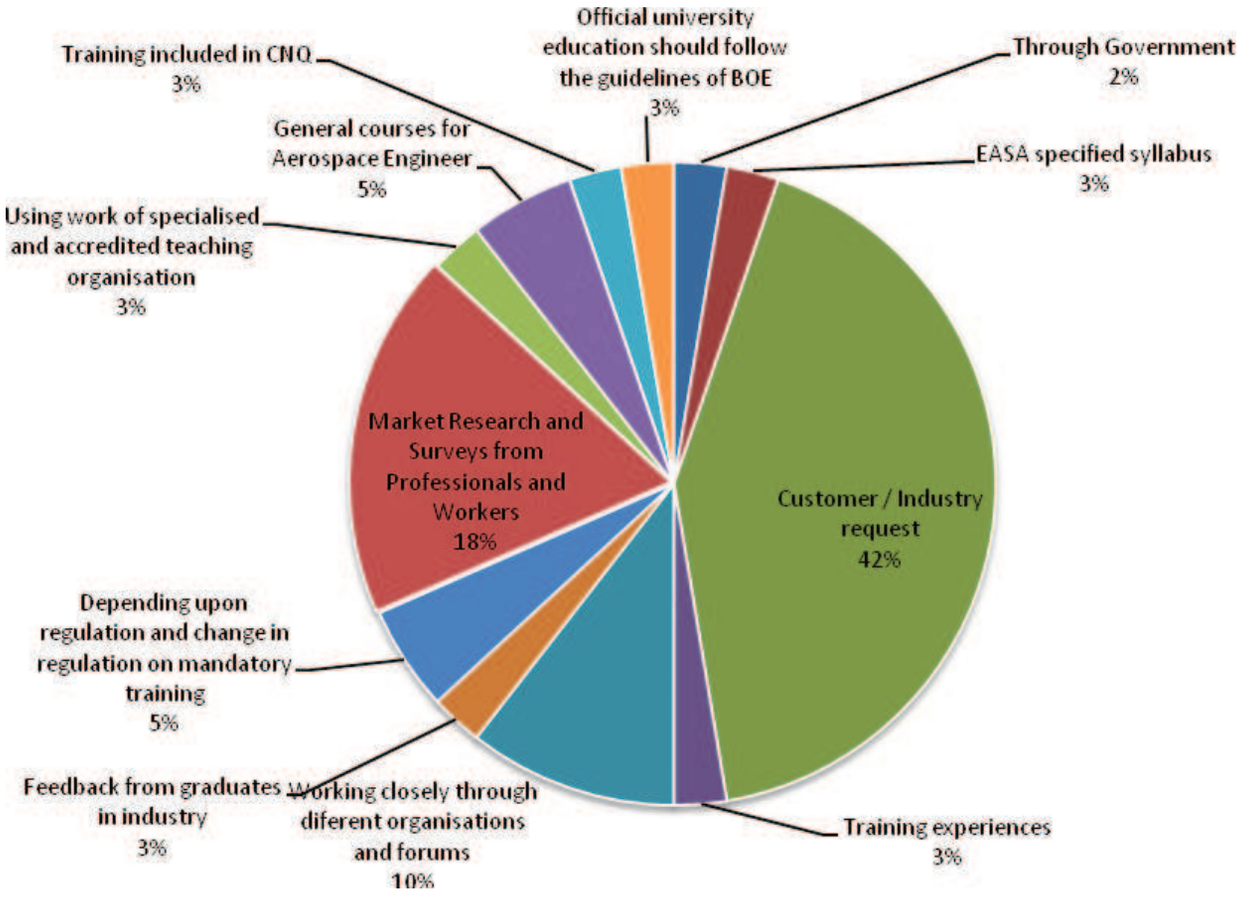

Figure 11. Drivers for the development of new courses as identified by the VET providers.

Both VET providers and trainers indicated that resource issues (manpower, money, lack of time and lack of expertise) were the main reasons why courses were not developed in areas where they had identified gaps (**Figure 12**).

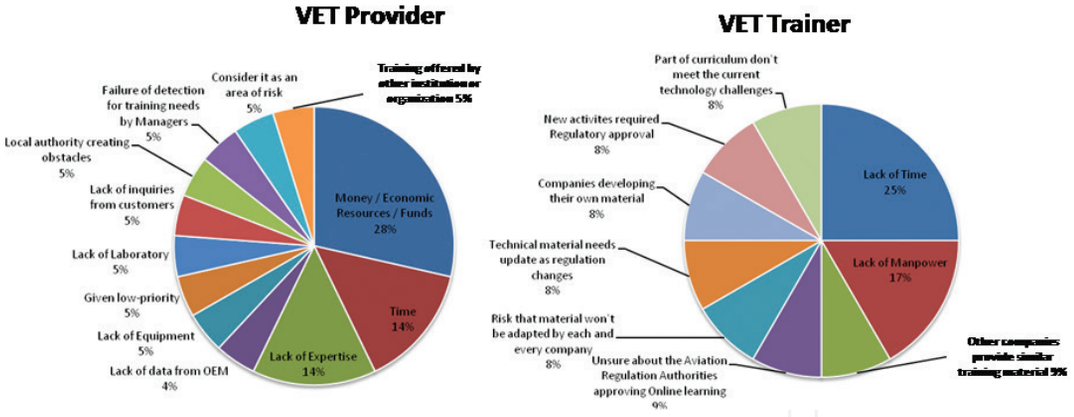

Figure 12. Reasons identified by VET providers and VET trainers why courses are not developed.

3.2.4. Summary of training requirements

The most frequently identified skills gaps are summarized in **Table 6**. The first column lists eight general skill gap areas that were most frequently identified. The second column highlights specific topics within these categories. There is some repetition of ATSEP, but this is included and illustrates that certain topics do not fit neatly into a single category.

Skills gap opportunities	
Aircraft ground handling	Baggage/Cargo handling systems Carriage of dangerous goods ATSEP (Air Traffic Safety Electronics Personnel) training for BPM (baggage handling)
Aircraft structural maintenance	Composite material Repair of aircraft structures (composite repair) Repair of aircraft structures (metallic repair) Nondestructive testing/Inspection of new composite materials
RPAV/UAS (remotely piloted air vehicle)	Air traffic control/integration with normal air traffic New national/European legislation (particularly with regard to RPAV) Single European sky legislation Performance based navigation
SMS (Safety Management Systems)	Training on SMS for aeronautical industry (CAP 760 implementation: FMECA, HAZOP, Event Tree methods) Aerodrome certification and Safety Management Systems: ICAO Annex 19 Risk Assessment techniques: identification & mitigation
Maintenance of specific Airport Operations	ATSEP (Air Traffic Safety Electronics Personnel) Training Maintenance and Inspection of equipment for Edge (light controls) Maintenance and installation of airport/runway lighting (CAP637 implementation: obstacle lighting & marking / aeronautical ground lighting)
Aircraft operation	Flight dispatch optimization (optimization of the scheduling of aircraft maintenance for items not part of the MMEL)
Aeronautical industry introduction	Key concepts and drivers in the aeronautical industry (could be airline, airport or aircraft driven). Provide new workers with introduction.
Human factors	

Table 6. Summary of frequently identified skills gaps (according to the questionnaires results).

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The main drivers for the development of new courses are meeting the needs of industry and the regulatory bodies. Currently, most courses are taught using traditional methods; however, the workers identified a desire for blended and practical-based delivery. Among the principal skill gaps, safety and human factors were often underlined.

3.3. Focus group study analysis

The focus groups **generally confirmed that the gaps identified** as part of the desk study and questionnaire analysis do exist. They also introduced some **new areas of skills gaps**. As result they inferred that:

- The main gaps identified with existing employees are associated with the less regulated sections of the industry and airport operations.
- Soft skills as management, communication, presentations are mentioned frequently as an area where further training is needed in the workforce.
- Human factors become a topic of interest, even more in connection with safety applications.
- Remotely piloted aircrafts or unmanned aircraft systems, was acknowledged as an emerging topic with increasing knowledge demand.
- Problems in recruiting skilled staff and the need to make youngers aware of job prospects are clearly recognized as upsetting.

3.3.1. Main findings on training and skills gaps

Potential skills and training gaps have been identified in the following areas:

- **Airport operations**: creation of open-source training materials that could be used outside of an airport training center may be beneficial in increasing recruitment but also providing new employee's basic knowledge of how an airport operates.
- **Manufacturing skills** are normally obtained via an apprenticeship and countries usually have their own defined systems. The gap mainly discussed in the literature is the lack of new entrants, therefore materials to inform and enthusiasm the youth to engage in apprenticeships were considered beneficial.
- **Regarding maintenance**, beside the high level of regulation, the production of materials that can be used to enhance training, an example being for those opting to carry out self-learning was considered beneficial; as well as the training the use of practical tools and methods and techniques to achieve the administrative, planning, and time management burden especially in a more electronic world. Also, some opportunities were found for enhanced training material to compliment the available texts and support learners with material constructed around the modular syllabus defined in EC 1149/2011. Annex III, Part-66, App I.
- A developing subject area, for which a future need is anticipated, is training for **remotely piloted aircraft systems**. There is very little official training presently available, and the topic is still being debated in terms of the levels of EU regulation.
- A training area that is growing in demand, and for which there is not much provision is **Air Traffic Safety Electronics Personnel** (ATSEP).

The project team decided that three subject areas should be explored in terms of developing/adapting training curricula and developing multimedia training materials in the second year of the project:

- **Maintenance**: a proposal was made to produce stimulating multimedia materials from some of the chapters included in the EASA maintenance basic license curricula, such as contents on helicopter aerodynamics, propulsion, and human factors.
- **Ground operations:** this broad subject area was highlighted in several pieces of work and by several countries, and gaps have been identified in the working knowledge of how an airport functions and how the various roles interact. The training currently undertaken has a significant vocational element. Most of the suggestions addressed knowledge required for increase safety and awareness of hazards at work, as well as human factors issues.
- **Human factors:** human factors was a topic of interest in all the phases of the study, including literature review, questionnaires, focus groups, and interviews. This theme has strong implications for maintenance workers and ground operations staff.

Human factors was nominated as crucial to familiarize new workers with the operation of an airport; to stress potential occupations and to give youth and public a closer outline of the aerospace industry.

4. Curricula design

One of the objectives of AIRVET was to produce a curricula bespoke to fill the skills gaps identified in the project and to complement the training offer inside the aviation domain [15]. The territorial analysis delineated four VET areas within the EU aeronautical industry that might benefit from enhancements [16]. All of them could be approached from the human factors perspective. Implementation of the human factors topic to address these areas is summarized in **Table 7**.

Target audience	Training need	Comments
Maintenance technician	Improvement in the teaching materials and soft skill development	Improve the training materials of the Human Factors module in the Part 66 approved training manual
Airport operation operatives	Up skilling and induction of workers to address skills/training gaps and improve operation safety	Provide exposure to human factors to address skills gaps. Short introductory course to the topics
Human factors as part of an induction for new workers	Awareness training of the subject and its importance	Its importance on the development of safety awareness and safety systems. The vehicle used to support the development of the other three areas
Future workers	New training material	Provide introductory training materials for future workers who have had no exposure to the subject or the "Aviation Culture."

Table 7. The 4 areas identified for development of training materials that utilizes human factors.

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Course title	Purpose	Course length	Module developed	Module length
EASA Part 66 maintenance course and human factors	Course is not changed, but module 9 on human factors has been developed to include planning and time management	Typically 2 years	Human factors in aircraft maintenance	50 h
Human factors in airport operations for new workers	An induction course for new workers comprising 5, 1 day, modules	1 week	An introduction to human factors in airport operations	8 h
Human factor awareness training for managers	Design of a module to support VET providers in developing an introductory human factors course for managers	As defined by the VET provider	Human factors in Airport Management	50 h
Airport industry introduction course	A short course, comprising of four modules, to attempt to enthuse young people about possible careers within an airport environment	1 day	Human performance and limitations	90 min

Table 8. A summary of the four courses and modules developed.

A summary of the four courses and the associated human factors modules are shown in **Table 8**. As it can be seen human factors are a common subject in each course, although the four courses target a different set of the aviation industry's employees, and the courses and learning resources have been developed for each target audience. The approach taken ensures that the training materials developed can be fully utilized by the target audiences and where necessary, complies with the EU aviation regulation framework.

The work required to design the curricula was split into a number of activities to ensure that the aims of the project were met (see **Figure 13**). The creation of the curriculum for each of the four training courses required the definition of course:

- A module is a separate unit of instruction. A course will be made up of a number of different modules, with each module covering a different topic area. Each module description contains detailed objectives, learning outcomes, indicative content, details of assessment, and resource requirements.
- A learning object is a short multimedia based training session [17]. They will correspond to a total of 2 h of multimedia presentations complemented with guidelines on how the training material can be implemented.

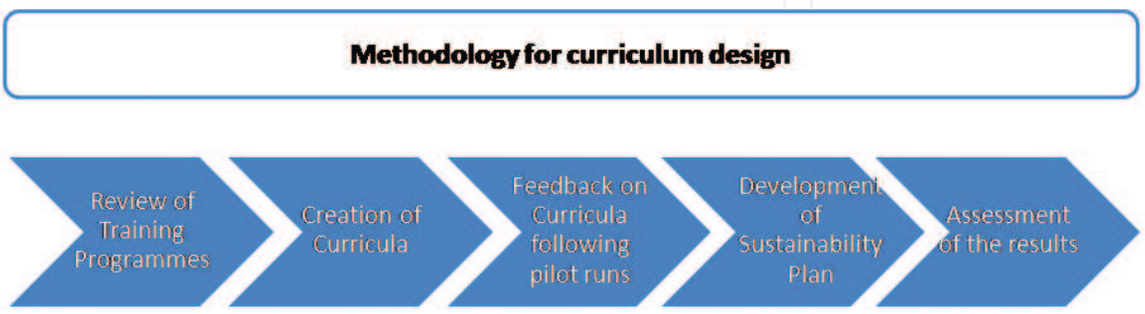

Figure 13. Strategy/methodology for curriculum design.

- A course descriptor is a document that defines the course and includes descriptions of the learning objectives and modules, besides other generic information about the course.
- Course documentation provides an overview of the course, the teaching approach and its component modules.

4.1. Curricula delivery

The curricula delivery aimed to produce new training materials around human factors topics for distinct target groups to meet the needs of the areas identified in the project and to provide trainees with a sufficient understanding of the value that human factors knowledge. The audience is made up of people that are not experts of what human factors is about; mainly students/future workers, maintenance technicians, and airport operations workers.

The AIRVET e-learning training materials includes four curricula, three learning objectives, and nine lessons, plus a detailed description of the multimedia materials developed highlighting contents, format, and target audience; including a manual for users to assist trainers in the use of the materials in the training courses. All materials are available in English, French, Italian, Polish, Portuguese, and Spanish.

Figure 14 provides details about the main topics and related sub-topics composing the AIRVET training materials. The lesson start with a story or a case study, includes exercises test the user's knowledge, and at the end of the lesson, a screen "Lesson learnt" display a list of the key concept to remember (see **Figure 15**). **Figure 16** presents some examples of the training units.

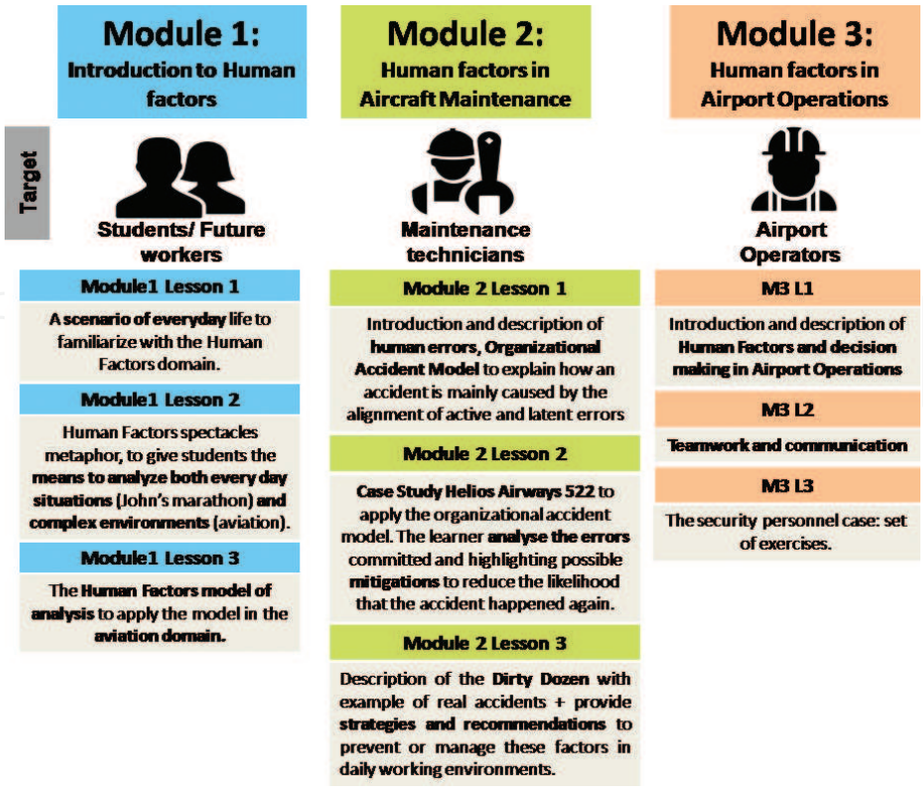

Figure 14. AIRVET e-learning materials.

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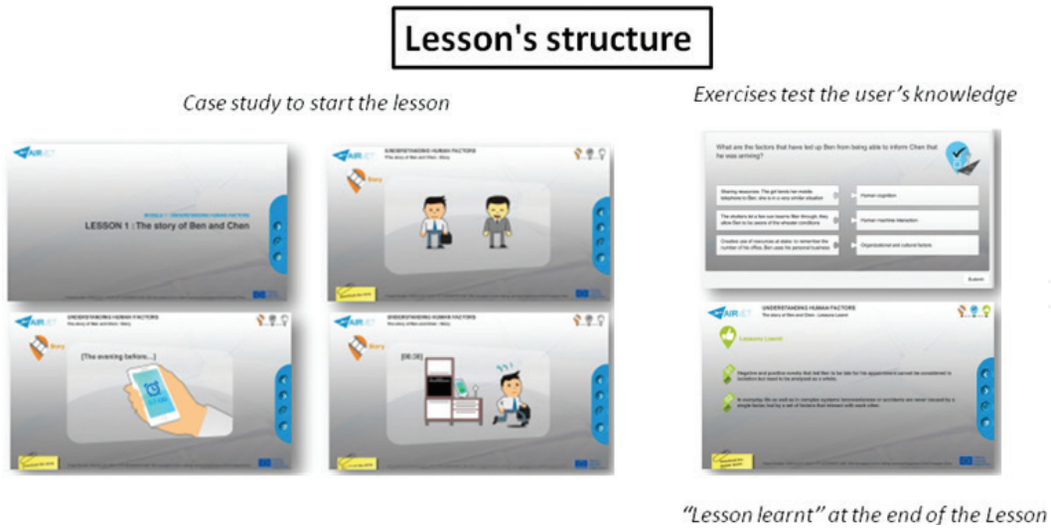

Figure 15. Lesson's structure.

4.2. Evaluation of the new multimedia on line training programs

Quality and effectiveness of the multimedia courses and materials become a key issue to guarantee the success of a training program specifically oriented to meet industry needs in regard to human factors skills and knowledge among its future staff [18]. The evaluation of this training program is therefore concerned with the determination of change in the student behavior and the change needed in the organizational structure where the student will be immerse [19]. Hence, training must be evaluated in this case as the process of developing skills, habits, knowledge, and attitudes for the purpose of preparing students for future positions and maximize their effectiveness [20]. To evaluate the effectiveness of such a process, some authors [21] have adapted a popular organizational training evaluation framework, the Kirkpatrick's four level model of training criteria [22], to the assessment of educational effectiveness in higher education.

Figure 16. Screenshots of a training unit slide (module 2).

Additionally, the assessment of HF training programs is particularly problematic because the difficulties in measuring effective improvements in human factures performances with standard test, such as motivation, social interaction, innovation, pride of work, etc. Kirkpatrick's model have also demonstrate in the past its suitability for summative evaluation of human issues programs [23].

Kirkpatrick model foundational principle is "The end is the beginning." Its philosophy is focused first on the desired results and second on the conduct required to achieve them. In that regard, instructors must identify the skills, knowledge, and attitudes that will result in the wanted performances.

The ultimate defy would be to build up a training package that aids the participants to absorb the knowledge they need and also to enjoy from the training program. Kirkpatrick is based on four stages evaluation procedure. The four level model consists of reaction, learning, behavior, and results criteria.

The project has organized pilot runs at four countries to test the learning materials. Pilot runs consist of a practical learning sessions in which the "dynamic" solutions developed (training materials) have been tested by trainees and workers in aerospace industry, and opinions from trainers and participants on the educational programs and innovative learning approaches have been collected. Pilot runs events have been held in four different countries: Spain, Italy, France, and Poland.

These pilot runs are essential to collect opinions both from trainers and participants on the training programs and innovative learning approaches, so the alliance can readjust them accordingly. More than 150 attendees have participated in the assessment. **Figure 17** summarizes the pilot run realized by the project.

Pilot Run exercises				
Module 1: Learning object: Understanding Human Factors		Module 2: Learning object: Human Factors in Maintenance		Module 3: Learning object: Human Factors in Airport Ground Operation
Poland June2015	**Italy June 2015**	**France September 2015**	**Italy June 2015**	**Spain September 2015**
47 participants	**34 participants**	**30 participants**	**6 participants**	**17+ 66 participants**
Young graduates and new AI workers	**Students and young graduates**	**Young graduates and new AI workers**	**Maintenance Experts and AI professionals**	**17 Airport and HF experts and AI professionals** **66 Young graduates /new AI workers in the airport domain**

Figure 17. Pilot run exercises.

http://dx.doi.org/10.5772/intechopen.70604

5. Conclusions

This paper illustrates the attempt made by AIRVET project to synthesize both current training needs and skill gaps in the aerospace industry, particularly at six European countries: Italy, France, Portugal, Poland, UK, and Spain.

To accomplished this objective the project performed a desk study, questionnaires from more than 500 people, interviews with managers and focus group with experts. The project attempted to triangulate the results to establish clear areas that would benefit from the development of vocational training.

The project have also identified and discussed the principal regulations that govern training syllabi and the skills gaps to cope with continuously evolving technologies. All those skill gaps can be tackle through well-planned lifelong learning programs. It was also indicated the benefits of better communications resources such as multimedia materials to revitalize education or broaden knowledge spreading.

From the desk research, a lack of information on skills gaps with employees was found. Many subject areas have been suggested as having skill gaps. Health and safety were the most relevant need that came out from the questionnaires, followed by human factors, safety systems, and management. The skill gaps were confirmed by the focus groups.

Soft skills were regularly cited as an area of concern for new entrants and also for current staff. One of the explanations of this need is that while technical skills are learned through formal training, it is not the case for soft skills that are mostly acquired through experience and not formal training.

Three subject domains were identified to be explored in terms of developing/adapting training curricula and developing multimedia training materials in the second year of the project:

- **Maintenance**: considering the 17 modules in the EASA "basic license," topics can be identified that could be used to produce exciting multimedia presentations: Module 12 on helicopter aerodynamics, Module 14 on propulsion, and Module 9 on introduction to **human factors**. In particular, this last topic has been **highlighted throughout this study as one where employees need additional education**. Improved training package for self-learning and additional materials for trainers and providers are envisage
- **Ground operations**: gaps have been identified in the working knowledge of how an airport functions and how the various roles interact. This gives an opportunity to develop and test learning materials. Most of the suggestions addressed knowledge required for increase safety and awareness of hazards at work, as well as human factors issues. These suggestions were aligned with a **human factors program** for ground operations.
- **Human factors**: human factors were a topic of interest in all the phases of the study, including literature review, questionnaires, focus groups, and interviews. This subject has **clear applications in maintenance and ground operations**. **It is worth concentrating on the production of human factor training materials which can unify our project and reach across subject areas and careers**.

The project has focused its efforts of developing training materials in the area of human factors. It has produced and validated four courses and nine e-learning lessons, all available in English, French, Italian, Polish, Portuguese, and Spanish.

The analysis of skills needs was used to develop and/or adapt training curriculum, including the definition of learning outcomes along with assessment and validation activities. Training materials with multimedia resources have also been developed and assessed. Additionally, the project has adapted a popular organizational training evaluation framework, the Kirkpatrick's four level model of training criteria, to the assessment of human factors multimedia training programs in aerospace engineering higher education. Pilot runs at 4 countries to test the learning materials. More than 150 attendees have participated in the assessment.

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References

[1] Royal Aeronautical Society UK Education and Skills Seminars. RAeS. London 30th April 2014, 2014.

[2] Bond D, 2014. Working together to deliver the skills that industry needs RAeS Education and Skills Conference. 1st October 2014 at Royal Aeronautical Society, London.

[3] Airbus 2014b. Commitment to Education [online] Available from: http://www.airbus.com/work/early-careers/commitment-to-education/

[4] European Union. Flightpath 2050—Europe's Vision for Aviation. Report of the High Level Group on Aviation Research. European Commission; 2011 ISBN 978-92-79-19724-6 http://doi.acm.org/10.2777/50266

[5] ASD Media group, 2007. ASD Report.

[6] CBI/Pearson, 2013. Changing the pace Available from: http://www.cbi.org.uk/media/2119176/education_and_skills_survey_2013.pdf

[7] Airbus 2014. Flying on Demand [Online] Available from: http://www.airbus.com/company/market/forecast/

[8] Ecorys 2009. FWC sector competitiveness studies-competitiveness of the EU aerospace industry with focus on: Aeronautics industry within the framework contract of sectorial competitiveness studies. ENTR/06/054 Final Report, Munich, 15 December 2009.

[9] Stuart M. Introduction: The industrial relations of learning and training: A new consensus or a new politics? European Journal of Industrial Relations. November 2007;**13**:269-280

[10] Lloyd C. Regulating employment: Implications for skill development in the aerospace industry, University of Warwick, UK, c.a.Iloyd@warwick.ac.uk. Journal of Industrial Relations. July 1999;**5**(2):163-185

[11] Hoekstra A, Crocker JR. ePortfolios: Enhancing professional learning of vocational educators. Vocations and Learning, May 2015. DOI: 10.1007/s12186-015-9133-4

[12] Chartered Institute of Logistics and Transport, 2015. Logistics & Transport Focus Magazine Bulletin. AIRVET Survey. Logistics & Transport Focus Magazine Bulletin, 3 volumen, 2015. Chartered Institute of Logistics and Transport. UK.

[13] Euroguidance, 2010 Evaluation. Report in 2010: Education, audiovisual and culture executive agency. Lifelong learning: EuroGuidance network Leonardo da Vinci, Grundtvig and dissemination. Activity Report

[14] Bsigroup, Brussells. ASD Aeronautical Industry 2012. AeroSpace and Defence Industries Association of Europe (ASD). 2012

[15] Jian-Li LI. Exploration and practice on the construction of practical training base in higher vocational education. Vocational and Technical Education.Volume 22. 2003

[16] Dayuan J. Thoughts on fundamental problems of vocational education pedagogy. Vocational and Technical Education. Volume 01. 2006

[17] Rooney D, Hopwood N, Boud D, and Kelly M. The role of simulation in pedagogies of higher education for the health professions: Through a practice based lens. Vocations and Learning. October 2015, Volume 8, pp 269-285

[18] Tack H, Vanderlinde R. Measuring teacher Educators' Researcherly disposition: Item development and scale construction. Vocations and Learning. 2016;**9**:43-62

[19] Chan S. Apprentices' learning of occupationally informed practical judgment. Vocations and Learning. October 2015;**8**(3):335-351

[20] Froehlich DE , Beausaert SAJ and Mien S R Segers; . Great Expectations: The Relationship Between Future Time Perspective, Learning From Others and Employability. Vocations and Learning, July 2015, Volume 8, Issue2, pp 213-227

[21] Praslova L. Educational Assessment, Evaluation and Accountability, August 2010, Volume 22, Issue 3, pp 215-225 First Online: 25 May 2010, Adaptation of Kirkpatrick's Four Level Model of Training Criteria to Assessment of Learning Outcomes and Program Evaluation in Higher Education. University of Southern California: Ludmila Praslova; August 2010

[22] Kirkpatrick DL. Evaluating Training Programs: The four Levels, Ed. n. Ed. 1998. San Francisco, California: Berrett-Koehler Publishers; 1998 an evaluation of Cdio approach to engineering

[23] Lynch R, Seery N, Gordon S. Education. University of Limerick, Ireland: Department of Manufacturing & Operations Engineering; 2008

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